AD-A103 951    BOEING AEROSPACE CO  HOUSTON TX                           F/G 15/6
ELECTRICAL ANALYSIS OF B-52/FB-111 AMAC AND RELEASE CIRCUITRY U--ETC(U)
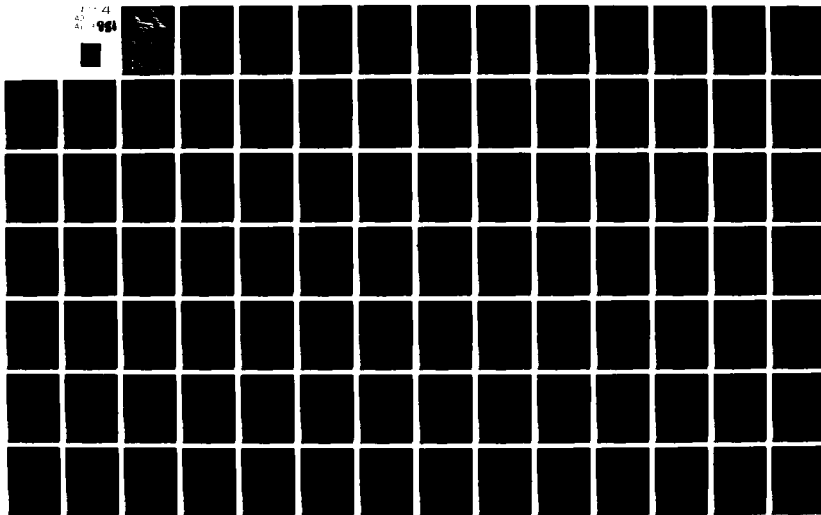OCT 75                                                  F29601-76-C-0017
UNCLASSIFIED   D2-118576-1                                            NL

D2-118576-1

LEVEL

BASIC ②

BS

AD A103951

DTIC
ELECTED
SEP 9 1981

H

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

# ELECTRICAL ANALYSIS OF B-52/FB-111 AMAC AND RELEASE CIRCUITRY UTILIZING SNEAK CIRCUIT ANALYSIS TECHNIQUE

— Final Report —

THE **BOEING** AEROSPACE COMPANY
HOUSTON, TEXAS
OCTOBER, 1975

81 5 26 107

# THE *BOEING* COMPANY

REV LTR

CODE IDENT. NO. 81205

NUMBER D2-118576-1

TITLE: ELECTRICAL ANALYSIS OF B-52/FB-111 AMAC

AND RELEASE CIRCUITRY UTILIZING SNEAK CIRCUIT

ANALYSIS TECHNIQUES - FINAL REPORT.

MODEL B-52/FB-111   CONTRACT F29601-76-C-0017

ISSUE NO. 13   ISSUED TO:

SNEAK CIRCUIT ANALYSIS GROUP
PREPARED BY ORG. 5-2932

SUPERVISED BY _E. G. Hill, Jr._

APPROVED BY _D. A. Heuer_

U3 4802 1430 ORIG. 4/65

# REVISIONS

| REV. SYM | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
|  |  |  |  |

HOU-3M-1116 (LSB) Approved 11 67 AJT

## ABSTRACT

This report summarizes the results of an electrical circuitry analysis of
B-52G and FB-111A aircraft monitor and control (AMAC) interfaces with nuclear
weapons.  The B-52G interface with the AGM-69A missile was also analyzed.
Sneak circuit analysis techniques were used to produce network trees.  The
network trees provided necessary circuit topology for power and load analysis
to identify feasible power sources to nuclear weapon interfaces in normal
and abnormal environments.  Preliminary results were presented to Air Force
Weapons Laboratory/SEC, Kirtland AFB, on 1 October 1975 for use in a nuclear
safety evaluation study.

## KEY WORDS

Air Force Weapons Laboratory/SEC
AGM-69A Missile
Aircraft Monitor and Control (AMAC)
B-52G Aircraft
Electrical Circuitry Analysis
FB-111A Aircraft
Network Trees
Nuclear Safety Evaluation
Power and Load Analysis
Sneak Circuit Analysis
Topology

-1-

ARRANGEMENT

| Document Number | Title | Subject |
|---|---|---|
| D2-1185761-1 | Final Report | Electrical Analysis of B-52/FB-111 AMAC and Release Circuitry Utilizing Sneak Circuit Analysis Techniques |
| D2-1185761-2 | B-52 Network Trees | B-52 AMAC and Release Circuitry |
| D2-1185761-3 | FB-111 Network Trees | FB-111 AMAC and Release Circuitry |

# CONTENTS

## CONTENTS (Continued)

## CONTENTS (Continued)

## CONTENTS (Continued)

## LIST OF FIGURES

## LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

## LIST OF TABLES

## 1.0 SUMMARY

This report documents the electrical circuitry analysis performed by Boeing Aerospace Company - Houston on Air Force contract F29601-76-C-0017. The study contributed to the AFWL/SE nuclear safety evaluation of B-52 and FB-111 aircraft directed by a joint ERDA/DOD steering group. The effort primarily involved evaluation of aircraft monitor and control (AMAC) circuitry for possible sneak circuits, and for currents or voltages to weapon interface connectors in normal and abnormal environments. Necessary data and documentation tasks were also performed. This report summarizes the study approach and results. Analysis packages and network trees are provided for possible use in a combined evaluation of the aircraft and weapons.

## 1.1 OBJECTIVE

The primary objective of the analysis was to identify latent electrical circuit paths and conditions that can cause unwanted functions to occur or which could inhibit desired functions with or without component damage due to normal or abnormal environments.

## 1.2 SIGNIFICANT FINDINGS

The most significant sneak circuit found is a bus-to-bus tie on the FB-111A. This condition will exist when stores jettison relays are energized, causing loss of both MAU Fire 1 and 2 commands to all pivot pylons. The sneak circuit analysis provided baseline data for the power and load analysis. Network trees developed by this task are documented in Volumes 2 and 3 of the report. Section 3 contains thirteen reports of sneak circuits, design concerns and drawing errors.

The most significant finding of the power and load analysis is that most weapon interface pins can be exposed to either 24/28VDC or 118VAC power when electrical elements have been damaged under crash and fire environments. These are the maximum voltages found in adjacent circuitry. No unlimited power sources were found. Results are documented in Section 4 of this report. Table 1.2-1 summarizes normal and worst-case fault analysis results.

TABLE 1.2-1   Power and Load Analysis Results - B-52/Gravity Weapons Interface
(Sheet 1 of 4)

| WEAPON INTERFACE | | ENVIRONMENT ANALYSIS RESULTS | | | | | | |
| DESIGNATOR | FUNCTION | NORMAL | | | ABNORMAL - WORST CASE | | | ANALYSIS PACKAGE |
| | | V | I | t | V | I | t | Section 4.1.6 |
| A114, J11, J12, J13 and J14 | Forward Bomb Bay Clip-In Connectors | Note: Power is DC unless otherwise noted. AC current is 400 Hz unless otherwise noted. | | | | | | |
| Pin A | IFC SAFING PWR | 24V | 75A | 3.5s | 24V | 109A | 1.4s | 4.1.6.7 |
| B | TESTER SW GND | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.7 |
| C | TESTER SW OFF/SAFE | 0 | 0 | - | 24V | 110A | 1.1s | 4.1.6.4 |
| D | TESTER SW AIR | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.7 |
| E | IFC SAFING PWR | 24V | 131A | 1.0s | 24V | 211A | .8s | 4.1.6.7 |
| F | TESTER SW SAFE | 0 | 0 | - | 24V | 109A | 1.2s | 4.1.6.6 |
| G | INFLIGHT TEST | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.7 |
| H | TESTER SW, READY | 0 | 0 | - | 24V | 150A | .8s | 4.1.6.6 |
| J | TESTER SW, AIR | 0 | 0 | - | 24V | 109A | 1.2s | 4.1.6.6 |
| L | INFLIGHT TEST | 0 | 0 | - | 24V | 152A | | 4.1.6.7 |
| O | WPN GROUND | GROUND | | | | | | |
| P | IFC SAFING PWR | 24V | 152A | 0.8s | 24V | 258A | .8s | 4.1.6.7 |
| R | INFLIGHT TEST | 0. | 0 | - | 24V | 152A | .8s | 4.1.6.7 |
| S | WPN GROUND | GROUND | | | | | | |
| J11,12T | FWD IFI PWR, 25A | 0 | 0 | - | 28V | 1170A | .8s | 4.1.6.3 (LH WPNS) |
| J13,14T | AFT IFI PWR, 25A | 0 | 0 | -' | 28V | 1000A | .8s | 4.1.6.2 (RH WPNS) |
| U | WPN GROUND | GROUND | | | | | | |
| V | WPN GROUND | GROUND | | | | | | |
| W | FWD IFI PWR, 15A | 0 | 0 | - | 28V | 800A | .8s | 4.1.6.3 |
| X | (OPEN) | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.8 |
| Y | FWD IFI PWR, 15A | 0 | 0 | - | 28V | 800A | .8s | 4.1.6.3 |
| Z | TESTER SW, AIR | 0 | 0 | - | 24V | 110A | 1.1s | 4.1.6.4 |
| a | TESTER SW, GND | 0 | 0 | - | 24V | 110A | 1.1s | 4.1.6.4 |
| c | TESTER SW, GND | 0 | 0 | - | 24V | 109A | 1.2s | 4.1.6.6 |
| d | IFC RELAY (FWD) | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.1 |
| f | TESTER SW, READY | 0 | 0 | - | 24V | 218A | .8s | 4.1.6.4 |
| h | FWD BOMB BAY SAFE | 0 | 0 | - | 24V | 152A | .8s | 4.1.6.5 |

TABLE 1.2-1 Power and Load Analysis Results - B-52/AGM-69 Interfaces
(Sheet 2 of 4)

| | WEAPON INTERFACE | ENVIRONMENT ANALYSIS RESULTS | | | | | | ANALYSIS PACKAGE |
| | | NORMAL | | | ABNORMAL - WORST CASE | | | |
| DESIGNATOR | FUNCTION | V | I | t | V | I | t | Section 4.1.7 |
|---|---|---|---|---|---|---|---|---|
| J1 | Missile Connector | | | | | | | |
| Pin 2 | BATTERY ACTIVATE | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 10 | ACCUMULATOR ACT. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 20 | SAF CLASS III A CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.8 |
| 26 | FIN UNLOCK | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 57 | PROPULSION SAFE | | | | | | | |
| | PYLON | 0V | 0A | - | 28V | 1115A | 1.5s | 4.1.7.5 |
| | LAUNCHER | 0V | 0A | - | 28V | 411A | 2.0s | 4.1.7.3 |
| 60 | SAF CLASS III B CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.8 |
| 82, 92, 96 | MISSILE ELECTRONIC POWER | | | | | | | |
| | PYLON SYS. ON | 28V | 254A | .45s | 28V | 1115A | 1.5s | 4.1.7.6 |
| | SYS. OFF | 0V | 0A | - | 28V | 1115A | 1.5s | 4.1.7.6 |
| | LAUNCHER SYS. ON | 28V | 368A | .2s | 28V | 1220A | 1.5s | 4.1.7.2 |
| | SYS. OFF | 0V | 0A | - | 28V | 1220A | 1.5s | 4.1.7.2 |
| 97 | SAF PREARM CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.1 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.1 |
| J1 | Ejector Connector | | | | | | | |
| Pin r | ARM SOLENOID | | | | | | | |
| | PYLON | 0V | 0A | - | 27V | 37A | 1.1s | 4.1.7.7 |
| | LAUNCHER | 0V | 0A | - | 27V | 54A | 1.1s | 4.1.7.7 |

TABLE 1.2-1 Power and Load Analysis Results - B-52/AGM-69 Interfaces
(Sheet 2 of 4)

| WEAPON INTERFACE | | NORMAL | | | ENVIRONMENT ANALYSIS RESULTS ABNORMAL - WORST CASE | | | ANALYSIS PACKAGE |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DESIGNATOR | FUNCTION | V | I | t | V | I | t | Section 4.1.7 |
| J1 | Missile Connector | | | | | | | |
| Pin 2 | BATTERY ACTIVATE | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 10 | ACCUMULATOR ACT. | | | | | | | |
| | PYLON | - | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 20 | SAF CLASS III A CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.8 |
| 26 | FIN UNLOCK | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .125s | 4.1.7.4 |
| 57 | PROPULSION SAFE | | | | | | | |
| | PYLON | 0V | 0A | - | 28V | 1115A | 1.5s | 4.1.7.5 |
| | LAUNCHER | 0V | 0A | - | 28V | 411A | 2.0s | 4.1.7.3 |
| 60 | SAF CLASS III B CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.8 |
| 82, 92, 96 | MISSILE ELECTRONIC POWER | | | | | | | |
| | PYLON SYS. ON | 28V | 254A | .45s | 28V | 1115A | 1.5s | 4.1.7.6 |
| | SYS. OFF | 0V | 0A | - | 28V | 1115A | 1.5s | 4.1.7.6 |
| | LAUNCHER SYS. ON | 28V | 368A | .2s | 28V | 1220A | 1.5s | 4.1.7.2 |
| | SYS. OFF | 0V | 0A | - | 28V | 1220A | 1.5s | 4.1.7.2 |
| 97 | SAF PREARM CMD. | | | | | | | |
| | PYLON | 0V | 0A | - | 118VAC | 983A | .125s | 4.1.7.1 |
| | LAUNCHER | 0V | 0A | - | 118VAC | 900A | .13s | 4.1.7.1 |
| J1 | Ejector Connector | | | | | | | |
| Pin r | ARM SOLENOID | | | | | | | |
| | PYLON | 0V | 0A | - | 27V | 37A | 1.1s | 4.1.7.7 |
| | LAUNCHER | 0V | 0A | - | 27V | 54A | 1.1s | 4.1.7.7 |

TABLE 1.2-1  Power and Load Analysis Results – FB-111/Station 3
(Sheet 3 of 4)

| WEAPON INTERFACE | | NORMAL | | | ABNORMAL – WORST CASE | | | ANALYSIS PACKAGE |
| DESIGNATOR | FUNCTION | V | I | t | V | I | t | Section 4.2.6 |
|---|---|---|---|---|---|---|---|---|
| J479013-3 | WPN STATION 3 | | | | | | | |
| Pin A | SAFE INPUT | 28V | 608A | .6s | 28V / 115VAC | 608A / 1983A | .6s | 4.2.6.2 |
| B | (NONE) | | | | | | | |
| C | SAFE INDICATION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s / -* | 4.2.6.5 |
| D | (NONE) | | | | | | | |
| E | GROUNDED | 0 | – | | | | | |
| F | GROUNDED | 0 | – | | | | | |
| G | WPN PRESENT (GROUND) | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s / -* | 4.2.6.5 |
| H | ARM INPUT | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| J | ARM INPUT | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| K | (NONE) | | | | | | | |
| L | (UNUSED) | 0 | 0 | | 28V / 115VAC | 608A / 451A | .6s / .6s | 4.2.6.3 |
| M | (NONE) | | | | | | | |
| N | (UNUSED) | 0 | 0 | | 28V / 115VAC | 608A / 451A | .6s / .6s | 4.2.6.3 |
| P | PAL MONITOR | 28V | 48mA | | 28V / 115VAC | 608A / 451A | .6s / .6s | 4.2.6.1 |
| R | ARM INDICATION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s / -* | 4.2.6.5 |
| S | SWITCHED TO GROUND | 0 | 0 | | 28V | 608A | .6s | 4.2.6.6 |
| T | (NONE) | | | | | | | |
| U | (NONE) | | | | | | | |
| V | PYLON CONTINUITY | 0 | 0 | | 28V | 608A | .6s | 4.2.6.6 |
| W | PYLON CONTINUITY | 0 | 0 | | 28V | 608A | .6s | 4.2.6.6 |
| X | WPN DROP CONFIG. RETARD | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| Y | (FUTURE CAPABILITY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| Z | BURST OPTION-AIR | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| a | (SRAM ONLY) | 28V | 48mA | | 28V | 608A | .6s | 4.2.6.3 |
| b | SAFE PROVISION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s / -* | 4.2.6.4 |
| c | (SRAM ONLY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.3 |
| d | WPN DROP CONFIG. FREE FALL | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| e | (FUTURE CAPABILITY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| f | BURST OPTION-GND | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |

*Indefinite

TABLE 1.2-1  Power and Load Analysis Results - FB-111/Station -R
Weapon Interface   (Sheet 4 of 4)

| WEAPON INTERFACE | | NORMAL | | | ABNORMAL - WORST CASE | | | ANALYSIS PACKAGE |
| DESIGNATOR | FUNCTION | V | I | t | V | I | t | Section 4.2.6 |
|---|---|---|---|---|---|---|---|---|
| J479013-R | RH WPNS BAY | | | | | | | |
| Pin A | SAFE INPUT | 28V | 1333A | .6s | 28V / 115VAC | 1333A / 3286A | .6s / .6s | 4.2.6.2 |
| B | (NONE) | | | | | | | |
| C | SAFE INDICATION | 28V | 48mA | -- | 28V / 115VAC | 1333A / 198mA | .6s / indefinite | 4.2.6.5 |
| D | (NONE) | | | | | | | |
| E | GROUNDED | | | | | | | |
| F | GROUNDED | | | | | | | |
| G | WPN PRESENT (GND) | 28V | 48mA | -- | 28V / 115VAC | 1333A / 198mA | .6s / indefinite | 4.2.6.5 |
| H | ARM INPUT | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| J | ARM INPUT | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| K | (NONE) | | | | | | | |
| L | (UNUSED) | 0 | 0 | -- | 28V / 115VAC | 1333A / 215A | .6s / .6s | 4.2.6.3 |
| M | (NONE) | | | | | | | |
| N | (UNUSED) | 0 | 0 | -- | 28V / 115VAC | 1333A / 215A | .6s / .6s | 4.2.6.3 |
| P | PAL MONITOR | 28V | 48mA | -- | 28V | 1333A | .6s | 4.2.6.1 |
| R | ARM INDICATION | 28V | 48mA | -- | 28V | 1333A | .6s | 4.2.6.5 |
| S | SWITCHED TO GND | 0 | 0 | -- | 115VAC / 28V | 198mA / 1333A | indefinite / .6s | 4.2.6.6 |
| T | (NONE) | | | | | | | |
| U | (NONE) | | | | | | | |
| V | (UNUSED IN WPN BAY) | | | | | | | |
| W | (UNUSED IN WPN BAY) | | | | | | | |
| X | WPN DROP CONFIG. RET | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| Y | (FUTURE CAPABILITY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| Z | BURST OPTION-AIR | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| a | (SRAM ONLY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.3 |
| b | SAFE PROVISION | 0 | 0 | -- | 115VAC | 198mA | indefinite | 4.2.6.4 |
| c | (SRAM ONLY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.3 |
| d | WPN DROP CONFIG-FF | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| e | (FUTURE CAPABILITY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| f | BURST OPTION - GND | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |

1.3     CONCLUSIONS

The following conclusions were reached:

o   The probability of abnormal voltage/currents being supplied to nuclear
    weapon interfaces, is considered to be very low, even in fire or crash
    environment, except as shown in this report.

o   The reported sneak circuits are the only ones to exist in the nuclear
    weapons monitor, control and release systems, based on available data.

o   Sneak circuit analysis provides an excellent baseline for fault analysis
    while defining all normal environment paths.

o   Wire-to-wire short circuits within common cables and crushed components
    can be expected in a crash causing abnormal continuities.

o   Limiting the scope of aircraft wiring harness fault analysis to wires
    within shared cables or connectors is considered practical and valid.

o   Techniques used in this study provide a number of fringe benefits:
    -   Design concerns identified.
    -   Input documentation accuracy cross checked.
    -   Good visibility of interfacing circuits.
    -   System configuration defined for all nuclear weapons monitor, control
        and release circuits.
    -   Electrical safety of these circuits examined.


1.4     RECOMMENDATIONS

Boeing recommends that AFWL/SEC

o   Continue with methods used for this analysis on other systems to be
    analyzed.

o   Provide access to input data as early as possible through cognizant ALC's.

o   Review findings from analysis to assess impact on weapon circuits.

## 2.0    ANALYSIS DESCRIPTION

This section describes the scope of the analysis, defines the tasks performed, and discusses the methods used.

## 2.1    SCOPE

The sneak circuit analyses performed on the B-52G and FB-111A aircraft were confined to circuitry pertaining to monitor, control and release of onboard nuclear weapons. The power and load analysis was confined to circuits which interface with the nuclear weapons and adjacent circuitry. Primary power, switched secondary power and control circuits were included as required.

Generalized aircraft damage modes and conditions under which they occur were studied to postulate circuit faults that could cause abnormal voltages and currents in wiring that interfaces with the nuclear weapon systems. For this analysis two operational modes were assumed: 1) Ground alert posture with power on and engines running, 2) flight (including taxi, takeoff and landing).

Sources that could possibly supply high voltage and current to wiring adjacent to direct nuclear weapon circuits were located and identified. Calculations were performed to determine voltage and current for each aircraft nuclear weapon system circuit at its interface with the weapon under both normal and faulted conditions. For these calculations each circuit was assumed grounded at the interface connector.

## 2.1.1    Configuration

The airplane configurations analyzed are as follows:

2.1.1.1   B-52G, Serial Number 59-2602, configured as follows:

> Forward Bomb Bay - Multiple Weapon Clip-In Assembly, Type MHU-20A/C
>> containing four bombs
> Aft Bomb Bay - AGM-69A Launcher containing only Missile no. 1
> Left Pylon - AGM-69A Ejector containing only Missile no. 1
> Right Pylon - Identical to Left Pylon

2.1.1.2    FB-111A, Serial Number 69-6514, configured as follows:

Weapons Bay - Right-hand (Station -R) MAU-12B/A, Aircraft Bomb
    Ejector Rack Assemblies, each containing a bomb.  (Left-
    hand station identical)

Left Pivot Pylon - Station -3, One MAU-12B/A, Aircraft Bomb Ejector
    Rack Assembly, containing a bomb.

Right Pivot Plyon - Identical to Left Pivot Pylon Station.

2.1.1.3    Analysis Assumptions and Exclusions

o    Interfaces with gravity bombs are the connectors shown in the
     aircraft wiring diagrams.

o    Interfaces with SRAMs are the connectors to the SRAM missile
     Internal SRAM missile circuits were excluded.

o    Aircraft circuits for SRAM guidance were excluded.

o    One SRAM weapons bay installation and one SRAM pylon station was
     analyzed in depth for the B-52G.  The other similar SRAM installa-
     tions were  analyzed for impacts of detail differences.

o    Analyses of abnormal environments considered only one fault at
     a time.

o    Wiring faults within aircraft wiring harnesses were limited to
     those within shared cables and connectors.  Cable-to-cable and
     bundle-to-bundle wiring faults were excluded.

o    Release circuits were not included as nuclear weapon interface
     circuits during load analysis for abnormal environments.

o    Short circuits in terminals and faults internal to components
     were not considered except in the worst-case abnormal environ-
     ment analysis for each model.

o    The abnormal environments analysis of the FB-111A escape capsule
     disconnects were limited to circuits related to nuclear weapons.

o    Circuits to the "Hound Dog" AGM were excluded.

o    FB-111A SRAM interfaces were excluded.

## 2.1.2    Definitions

*Some terms used in this study require specific definitions for clarity.* The following definitions apply throughout this report:

### Normal environments

These are the conditions present on an aircraft during ground alert operations with no faults postulated due to component damage, or abnormal temperature, forces, radiation or other out-of-tolerance influences from the aircraft surroundings.

### Abnormal environments

For the purposes of the analysis, the abnormal environments that were considered were damaging temperatures and mechanical forces due to fuel-fed fire for aircraft on ground alert status and fuel-fed fire or crash for aircraft in flight.

### Power and load analysis

This consisted of determining open circuit voltage and short circuit current on each weapon system interface wire under normal and faulted conditions.

### Fire on ground alert

A fire fed by aircraft fuel such that damaging temperatures and forces reach the circuits of concern while power is still applied to them.

### Fire and crash in flight

An intense fire in flight fed by fuel and slipstream.  Inflight crash involves collision or structural breakup resulting in mechanical forces that cause damage and introduce abnormal current paths such as conductive structural debris in contact with circuits of concern.

2.1.2    (Continued)

### High voltage and current

Any AC or DC voltage or current exceeding normal operating values, allowing for tolerances.

### Electrical faults

These are the logical results from the damage modes.  They are of the following types:
1.    Open weapon system circuits in components and wiring.
2.    Shorted wires in junction boxes, components, cables and connectors containing circuits that lead to nuclear weapon interfaces.

### Damage

The physical result of fire or crash as defined above.  Damage modes are generalized categories such as shear, rupture, collapse, melting, and perforation.

### Worst-case conditions

Worst-case conditions assumed power on all systems, all engines running and fire on ground alert, or fire/crash in flight, as defined above.

### Power profile

Plots of short circuit current versus time on each weapon system interface wire.

### Interfacing circuits

Any circuit that can directly affect nuclear circuits.

### Adjacent wiring

Wires that physically share the same cable or connector but do not electrically interface with the nuclear weapon system circuits.

2.1.2     (Continued)

### Transient suppression

Components/circuits that will reduce voltages from inductive loads such as relays, motors or solenoids.

### Direct nuclear circuit

Any circuit that has a current path into the nuclear weapon interface without an interrupting device.  Resistors and relay coils are assumed to continue the current path.  Switches, circuit breakers and relay contacts stop the current path.

## 2.2     TASK DESCRIPTIONS

The following tasks were performed:

### 2.2.1     Data Requirements and Handling - Task 1

Boeing received, catalogued and filed documents such as wiring diagrams, schematics, wire lists and other input data that defined electrical continuity, operation, and subsystem functions to be analyzed by aircraft model.  Appendix A lists technical data utilized for the analysis.

### 2.2.2     Electrical Paths and Network Trees - Task 2

Boeing processed the input data to identify all continuity paths.  Network trees were prepared for the sneak circuit analysis and power/load analysis efforts described below.

### 2.2.3     Sneak Circuit Analysis - Task 3

Boeing performed a sneak circuit analysis of each aircraft model in the ground alert and flight modes assuming a normal environment.  The analysis used the network trees developed in Task 2.  Boeing identified potential sneak circuit conditions such as:

o     Sneak paths which may allow current or voltage to flow along an unexpected route to a nuclear weapon or SRAM interface.

o     Sneak timing which may actuate or inhibit a function at an unexpected time.

2.2.3    (Continued)

o    Sneak indications which may cause an ambiguous or false display
     of system operating conditions to the flight crew.

o    Sneak labels which may cause incorrect stimuli to be initiated
     by the flight crew.

## 2.2.4    Power and Load Analysis - Task 4

Boeing performed a power and load analysis under worst-case environ-
ment conditions with the aircraft on ground alert.  This assumed that
power is on all circuits of concern and that all engines are running.
Boeing calculated maximum power duration and profile in direct and inter-
facing circuits and in wiring adjacent to exposed nuclear weapon system
circuits.  Maximum currents were calculated for each circuit path assuming
zero impedance to ground at the weapon interface.  Sources were identified
that could possibly supply high voltage or current on wiring that inter-
face with nuclear weapon circuits.  Expected failure modes resulting from
abnormal environments (fire) were considered in this task to the extent
that they could affect the voltage and current available to the weapons.
Abnormal environment was limited to fire for ground alert and fire or
crash for flight mode.

## 2.2.5    Documentation - Task 5

Boeing documented the analyses as described below.

### 2.2.5.1    Potential Sneak Circuit Conditions

Sneak circuit conditions found were described and documented.  Sketches
of the circuits are included when appropriate.  Recommendations for appro-
priate corrective action are given along with references to supporting
documentation.

### 2.2.5.2    Undesirable Circuit Conditions

Undesirable circuit conditions found during the analysis are described
on design concern reports.  Circuit paths that could deliver high power to
nuclear weapon interfaces as a result of fire and crash environments are
identified in Circuit Analysis Packages.  During the performance of the analysis,

2.2.5.2    (Continued)

when the following conditions were apparent, they were also described
and reported on Design Concern Reports:

o    Single failure points

o    Unnecessary circuitry or components

o    Improper implementation of redundancy

o    Lack of transient suppression or improper suppression for in-
     ductive loads

o    Improper application of components

2.2.5.3    Drawing Errors

Drawing errors and other discrepancies found in the input data for the
analysis were identified and documented.

2.2.5.4    Analysis Effort Summary

The analysis effort was summarized to include: the Scope, Method, Con-
clusions and Recommendations at the completion of the analysis tasks.

2.3    METHODS

The chart in Figure 2.3-1 shows graphically how the total analysis was per-
formed and the interaction between the sneak circuit portion and the power
and loads analysis.  The following paragraphs describe in detail how each
analysis was performed.

2.3.1    Sneak Circuit Analysis Methods

The Sneak Circuit Analysis (SCA) techniques and associated computer pro-
grams developed by The Boeing Aerospace Company were designed to be applied
to a broad range of electrical/electronic systems including the B-52G and
FB-111A special weapons monitor, control and release systems.  The methods
described were applied directly.

Specifically, the methods used to conduct the analysis of these systems
included an input phase, a processing phase and an analysis phase. Figure 2.3-2
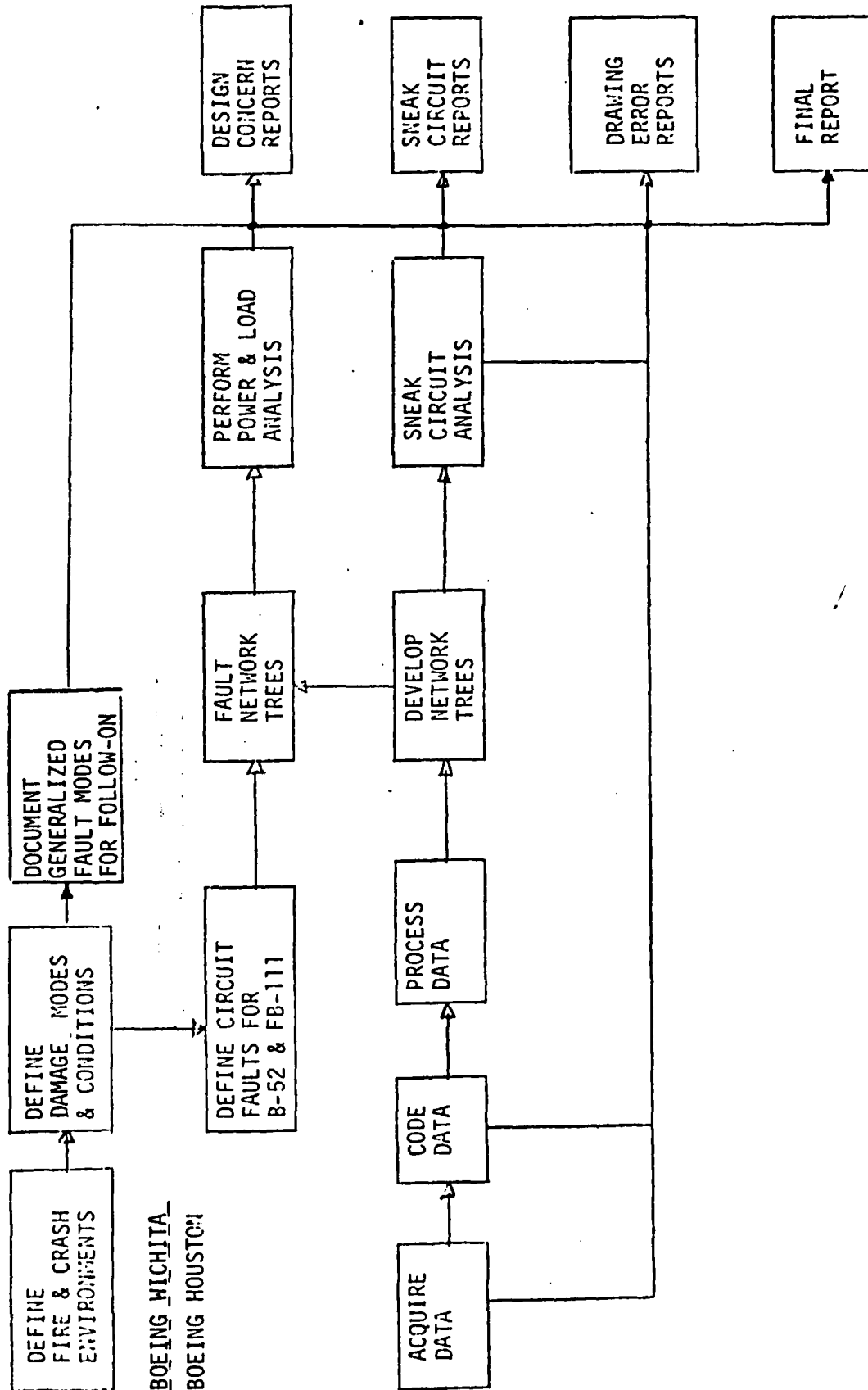
Figure 2.3-1 "B-52/FB-111 ANALYSIS WORK FLOW"

## 2.3.1 (Continued)

shows the steps involved in these phases and their relationship.

### 2.3.1.1 Input Phase

Data supplied by the Air Force Weapons Laboratory were converted into the proper format for use by the computer. Input data was manually encoded from the detail schematics and wiring diagrams. The computer generated a masterfile from this data. Several automatic audit and edit functions were performed while generating the masterfiles. The masterfiles were then verified by a second analyst. The masterfile was updated as necessary to correct any discrepancies noted. By using manufacturing level data and performing necessary audit and edit functions, an accurate data base was insured. Drawing errors discovered have been reported.

### 2.3.1.2 Computer Processing Phase

The masterfiles generated in the input phase formed the data base for the path search program. One of the outputs of the run was the Open End (O.E.) Report. This report identified all the path segments that are not connected to another segment, power or ground. All unintentional open ends were resolved and the masterfiles updated. The O.E. Report is one method of discovering drawing errors, i.e., mismatched connector numbers, connector pin numbers, etc.

The next major step was the path search which established all possible paths by stringing together all records with point to point continuity. All data input to the search program was accounted for in the Used and Unused Data Record indices. Matrix reports were generated identifying all paths, intersect nodes and path types. Several other reports (terminal branch, switch branch, special node cross reference, etc.) were produced at this time to present supplementary information used during the analysis phase.

### 2.3.1.3 Analysis Phase

The outputs of the computer processing phase were collated into nodal set

# COMPUTER-AIDED SNEAK CIRCUIT ANALYSIS
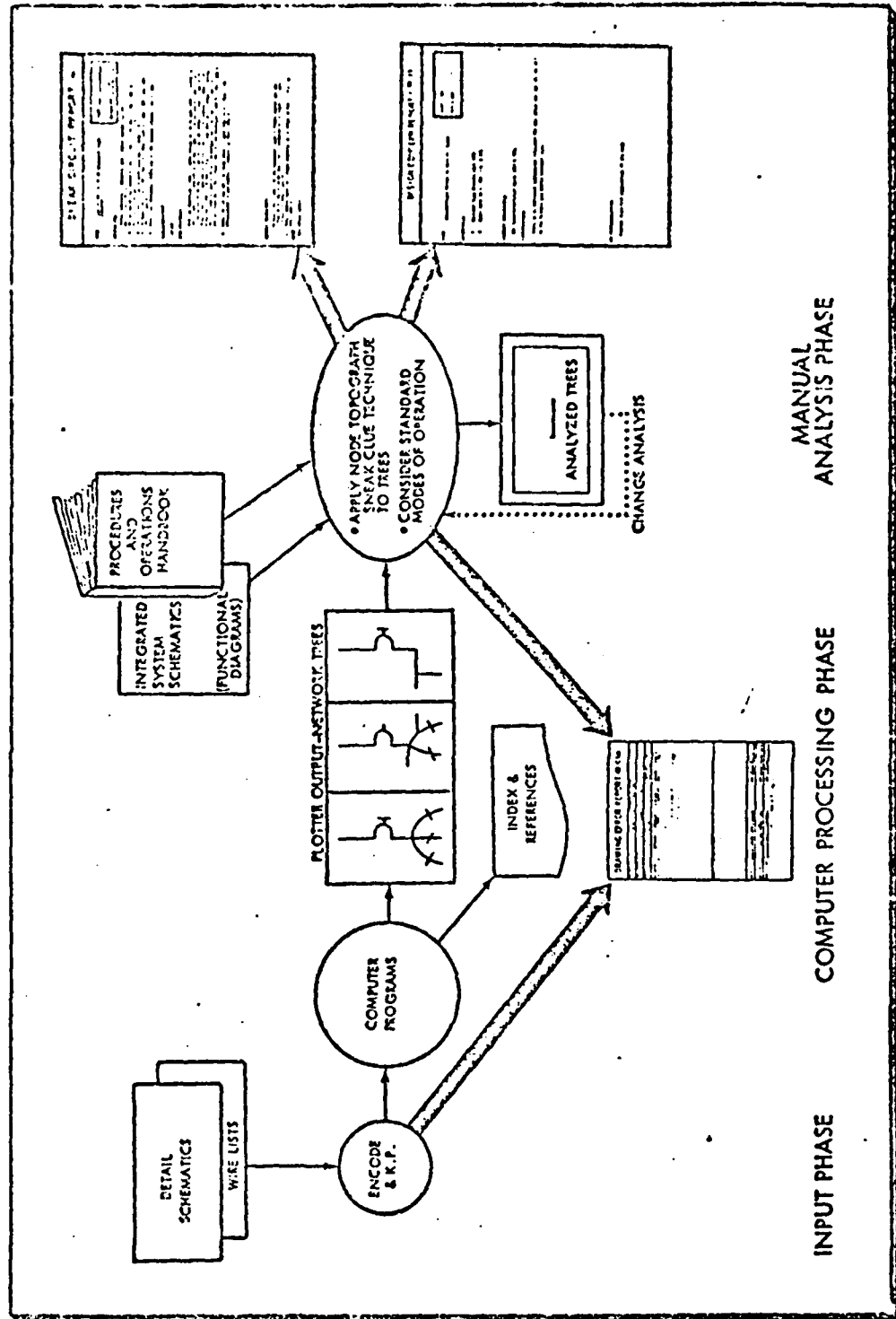
Figure 2.3-2. Sneak Circuit Analysis Work Flow

INPUT PHASE · COMPUTER PROCESSING PHASE

COMPUTER PROCESSING PHASE · MANUAL ANALYSIS PHASE

## 2.3.1.3 (Continued)

packages. These packages contained the network trees, matrix reports and the various reference reports peculiar to each nodal set. The analyst then prepared "node topographs" for the network trees. Topological network trees show the electrical power source (voltage input) at the top and the electrical return (ground) at the bottom of the figure. The only exception to this was a network tree with digital logic in which case the tree was drawn in a left to right manner. All nodes (intersection of three or more branches) were structured into levels between power and ground, and they were separated into levels or from one another by branches containing a switching device, a load (impedance), or a diode.

The use of topological network trees is a feature which greatly facilitates the analysis by clearly showing all connections at each electrical node. It also eliminates extraneous circuit routing detail and drafting line layout problems which can handicap an analysis to the extent of hiding sneak circuits. Therefore, topological network trees were essential to successful electrical Sneak Circuit Analysis.

Another key element in electrical Sneak Circuit Analysis development came with realization that the clues can be divided into groups with each group applying to an individual node topograph. Node topographs are the patterns which geometrically describe node connections in topological network trees. The node topographs recognized to exist in electrical network topology are presented in Figure 2.3-3. All electrical nodes in a topological network tree will fit one of these patterns. More complex patterns encountered can be broken into component parts represented by these basic patterns. The actual analysis was then performed by identifying all possible modes of operation, eliminating those that are not possible by switching or other restrictions and then determining if the remaining circuits perform as intended by the designer. The analyst applied a list of approximately forty "sneak circuit clues" to each nodal set. Potential "sneak" conditions and design concerns were reported along with the recommended corrective action.
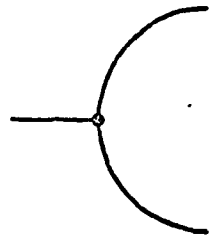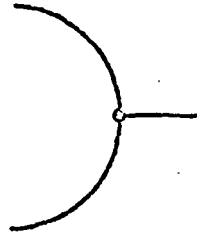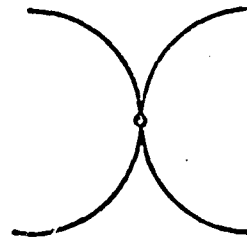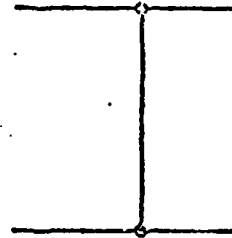
Figure 2.3-3. Electrical Network Node Topographs

## 2.3.2    Power and Load  Analysis Method

The power and load  analysis was performed for both normal and abnormal
environment conditions.

### 2.3.2.1    Definition of Environments and Fault Modes

The power and load analysis involved normal and abnormal environments for
nuclear-loaded ground alert and operational flight postures.  Boeing defined
the environments as shown in Table 2.3-1.  There is very little difference
in electrical effects between flight and ground alert.  Perhaps the basic
difference is ambient temperature which has a significant effect upon
circuit breaker trip times.

TABLE 2.3-1  ENVIRONMENTS AND FAULT MODES

| OPERATIONAL POSTURE | ENVIRONMENT DEFINITION | | FEASIBLE FAULT MODES |
|---|---|---|---|
| | ENVIRONMENT | CONDITIONS | |
| GROUND ALERT | NORMAL | o  AIRCRAFT PARKED<br>o  ALL ENGINES RUNNING<br>o  POWER ON ALL BUSSES<br>o  AMBIENT T = 25°C | NONE |
| | ABNORMAL | o  AIRCRAFT PARKED<br>o  ALL ENGINES RUNNING<br>o  POWER ON ALL BUSSES<br>o  POWER ON ALL CIRCUITS OF CONCERN<br>o  FIRE LOCATED IN AREA OF CONCERN<br>o  AMBIENT T = 25°C | o  ADJACENT WIRES/ADJACENT PINS SHORTED TOGETHER<br>o  WIRES IN COMMON CABLE FAULTED OPEN/ OR SHORTED TO GROUND<br>o  COMPONENTS/EQUIPMENT SHORTED TOGETHER OR TO GROUND<br>o  POWER LOSS FROM FAULTED COMPONENT |
| FLIGHT | NORMAL | o  AIRCRAFT FLYING NORMAL MISSION PROFILE<br>o  ALL ENGINES, GENERATORS, TR'S, BATTERIES OPERATING<br>o  POWER ON ALL BUSSES<br>o  AMBIENT T = -54°C<br>o  CREW COMPARTMENT T = 25°C | NONE |
| | ABNORMAL | o  ALL ENGINES RUNNING<br>o  POWER ON ALL BUSSES AND CIRCUITS OF CONCERN<br>o  CRASH DAMAGE IN AREA OF CONCERN<br>o  FIRE IN AREA OF CONCERN<br>o  AMBIENT T = -54°C | o  ADJACENT WIRES/ADJACENT PINS SHORTED TOGETHER<br>o  WIRES IN COMMON CABLE FAULTED OPEN/ OR SHORTED TO GROUND<br>o  COMPONENTS/EQUIPMENT SHORTED TOGETHER OR TO GROUND<br>o  POWER LOSS FROM FAULTED COMPONENT |

## 2.3.2.2   Normal Condition Calculations

The network trees that show the weapon interfaces and interfacing circuitry were analyzed as to voltage sources and current paths to the weapon interface. Path resistance was determined from the voltage source to the weapon inter- face where current paths were determined to be possible under ground alert or normal inflight checkout.  This resistance was obtained from cable assembly drawings, wiring specifications, aircraft dimensions and cable routing.  It was assumed for this analysis that arming functions and code switching were not normal conditions, but monitor, station select and safing functions might be performed.  The current profile was then determined from the voltage source and path resistance assuming a ground at the weapon interface.  Open circuit voltage was determined to be the source voltage assuming an open circuit at the weapon interface.

## 2.3.2.3   Fault Condition Calculations

The network trees that show the weapon interfaces and interfacing circuitry were analyzed as to possible voltage sources under fault conditions.  The computer generated path reports were used to determine each connection and wire segment in the direct and interfacing circuitry.  These were used with the computer generated output data index, technical orders, wiring diagrams, schematics and cable assembly drawings to determine powered circuitry in common cables, connectors or component assemblies.  Under fault conditions it was assumed that any powered circuits could short into the direct or connected interfacing circuits where they exist in common cables, connectors or com- ponent assemblies.  A sketch was prepared for each weapon interface pin to show the direct circuitry and adjacent circuitry.  Potential points where faults could occur were identified on the sketches and on the network trees. The worst case path for each weapon interface was determined from examination of the above data considering the power source voltage, wire lengths and wire sizes.  Resistance of the faulted path was determined from the cable assembly drawings, wiring specifications, aircraft dimensions and cable routing.  The worst case path for each weapon interface was shown on a sketch that identifies

2.3.2.3    (Continued)

the fault area, resistance of the path and the voltage source.  Maximum
current was calculated assuming a ground at the weapon interface.  Open circuit
voltage was determined assuming an open circuit at the weapon interface.  Time
duration of the current was determined using manufacturer's data and governing
specifications of the circuit breakers that supplied the circuits.

## 3.0   SNEAK CIRCUIT ANALYSIS OF B-52G & FB-111A

A Sneak Circuit Analysis of the Monitor & Control and Weapons Release systems of the B-52G and FB-111A aircraft was performed with the aid of a digital computer.

### 3.1   SUMMARY

The analyses of the systems of each aircraft were based on electrical wiring data from technical manuals. Circuit evaluation was limited to pertinent portions of the subsystems, and excluded circuitry internal to the weapons. The results of the B-52G analysis were three sneak-circuit reports describing erroneous indicator lights, two design concern reports describing unnecessary components and a single failure point, and one drawing error report. The FB-111A analysis resulted in two sneak circuit reports describing a sneak inhibit and a bus-to-bus tie, and five drawing error reports. Copies of all reports are included in Sections 3.4, 3.5 and 3.6 respectively.

### 3.2   CONDITIONS AND ASSUMPTIONS

The B-52G and FB-111A sneak circuit analyses were based on electrical wiring diagrams contained in technical manuals. The information shown on these drawings was of sufficient detail for component interconnections and generally sufficient for circuits internal to component "Boxes". Supplementary information was obtained from functional/integrated drawings and system descriptions from additional technical manuals.

Specifically, the circuitry of each aircraft that was analyzed was limited to the portions of the Weapons Release and Monitor and Control Systems for which electrical wiring data was available. Circuitry in other systems which interfaced with the aforementioned systems was considered out of scope. No circuitry internal to the gravity weapons or the AGM-69A was included in the analysis. Assumptions were made for components on which detail electrical data were not available, based on the supplementary information.

### 3.3   NETWORK TREES

The network trees derived from computer processed B-52G and FB-111A data were analyzed for sneak circuit conditions. The trees were uniquely identified according to aircraft, numbered, and titled for reference and cross-reference between trees. Copies of all network trees for B-52G and FB-111A aircraft are included as Volumes 2 and 3.

## 3.4  SNEAK CIRCUIT REPORTS

Five sneak circuit conditions were discovered during the analysis of aircraft systems. Three sneak circuit reports (SCR's) resulted from B-52G analysis, and two SCR's from FB-111A analysis. Copies of these SCR's are presented in the Figures listed below.

| SCR Number | Subject | Figure |
|---|---|---|
| B-52G-1 | DCU-9/A Warning Light | 3.4-1 |
| -2 | Master Bomb Control Power Indicator | 3.4-2 |
| -3 | AGM-69A Power Distribution Indicator | 3.4-3 |
| FB-111A-1 | Tail Arming Solenoid | 3.4-4 |
| -2 | Essential Bus to Main Bus Tie | 3.4-5 |

## SNEAK CIRCUIT REPORT B-52G-1

TITLE    DCU-9/A Warning Light Provides
         False Indication.

DATE __8-27-75__

ENGINEER __M. Garnett__

REFERENCES

1) USAF T.O. 11N-T5009-2 change 6, para. 4-1.2 Warning Indicator
2) USAF T.O. 1B-52B-2-31 change 32, page 3-83, figure 3-20
3) USAF T.O. 1B-52B-2-23, A8F.00 Rev JH
4) USAF T.O. 1B-52B-2-23, A8.14 Rev KM

MODULE/EQUIPMENT

DCU-9/A/B52-G

EXPLANATION

Per reference 1, the DCU-9/A Warning Indicator is used to indicate undesirable external conditions or to test certain external circuits for continuity. When the forward readiness switch S619 is in the SAFE position and the DCU-9/A rotary switch is in the GND or AIR position, relay K502 in the readiness panel will energize removing J11, J12, J13, and J14 pins G and L from the warning indicator circuit by opening the normally closed K502 contacts. Closure of the normally open K502 contacts will illuminate the warning indicator falsely implying an undesirable external circuit condition even though the indicator is not connected to an external circuit. Power is still present on J11/A through J14/A to "safe" the weapon. See figure 1.

POTENTIAL IMPACT

False indication of an undesirable external condition when an undesirable internal condition exists.

RECOMMENDATION

Change reference 1 and other documentation as necessary to show that the DCU-9/A warning light may also indicate an undesired switch configuration in addition to undesired external circuit conditions.

Figure 3.4.1, Page 1

THE *BOEING* AEROSPACE COMPANY - HOUSTON. TEXAS

Figure 1 - DCU-9/A Warning Light Circuit
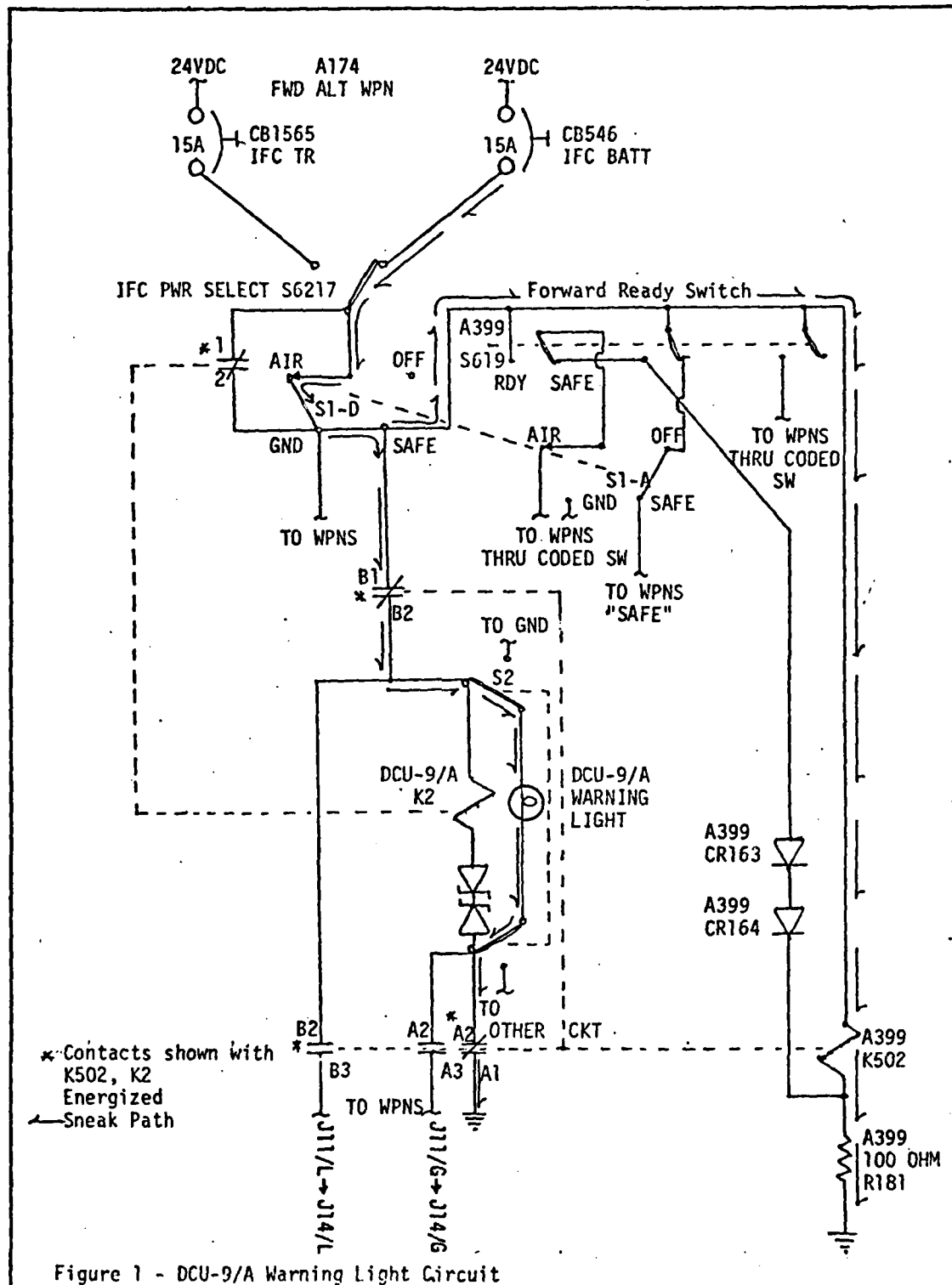
Figure 3.4.1, Page 2

# SNEAK CIRCUIT REPORT B-52G-2

TITLE    Erroneous Master Bomb Control Power
On Indicator

DATE ___8-27-75___

ENGINEER ___L. Bose___

*jk.*

## REFERENCES

1) T.O. 1B-52G-2-23, change 16, Electronic Wiring Diagrams and Data,
Diagrams A6.02, A4.38, A3.32.
2) T.O. 1B-52G-2-31, change 38, Bomb Release Systems, pages 2-1, 2-3 & 3-1.

## MODULE/EQUIPMENT

B-52G/A234

## EXPLANATION

Figure 1 shows DS155, the "Power On" indicator in A234, Master Bomb Control Panel.
This indicator is supplied power through CB411 (A174), S302 (A234) and S151 (A234),
the Master Bomb Control Power On/Off switch.  This indication shows only that power
from CB411 and S302 has been switched through S151.  It does not accurately indicate
that the Master Bomb Control Power On function has been accomplished through S151
switching.  Three other wafers of S151 switch control power from CB284 and CB409.
The present configuration of DS155 cannot monitor that control power from CB284
and CB409 has been switched through S151.

## POTENTIAL IMPACT

DS155 could provide indication that power is on when it may be partially or totally
interrupted by CB284 or CB409.

## RECOMMENDATION

Change all applicable documentation to show that DS155 may not indicate power on
function.

Figure 3.4.2, Page 1

THE *BOEING* AEROSPACE COMPANY - HOUSTON, TEXAS

Figure 1 - Erroneous Power On Indicator

⟐DS155 Cannot indicate the status of control power from CB409 or CB284.
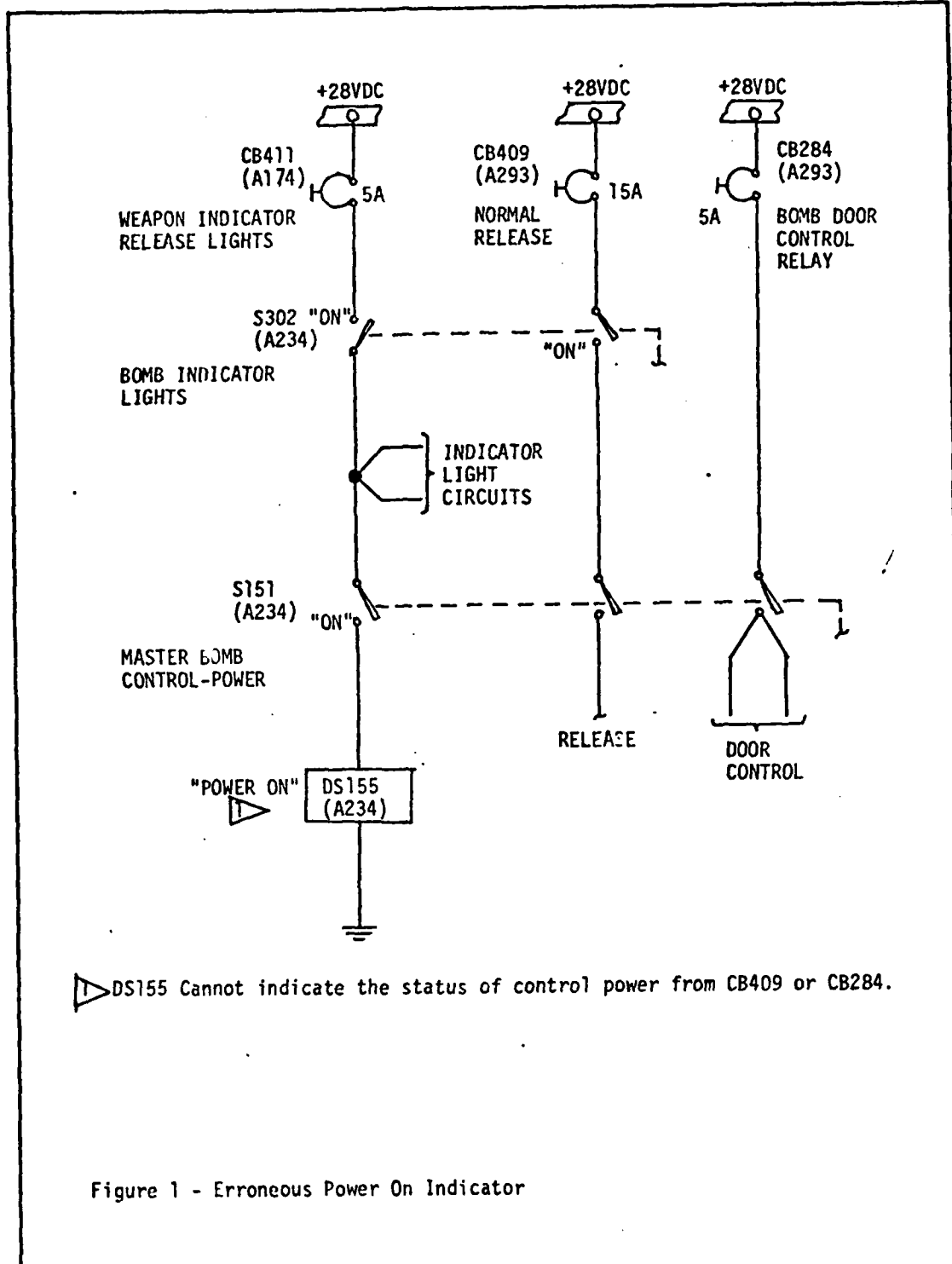
Figure 3.4.2, Page 2

---

# SNEAK CIRCUIT REPORT B-52G-3

TITLE    Erroneous Indicator In AGM-69A
         Power Distribution

DATE ___9-4-75___

ENGINEER L. Bose

REFERENCES

1) T.O. 1B-52G-2-23, change 16, Electronic Wiring Diagrams and Data,
   pages Y6B1M.03 & Y6B1U.04.
2) T.O. 1B-52G-2-12, change 55, Electrical Systems, pages 3-51, 3-52,
   3-53, & 3-54.

MODULE/EQUIPMENT

B52-G/AGM-69A PWR DIST. BOX

EXPLANATION

Indicator DS439 in A482, AGM-69A Power Distribution Box, does not indicate
"Hydraulic Pump T. R. On" as its label suggests.  DS439 shows only that K659 the
Hydraulic Pump T. R. Ground Check Relay has been energized.  A true "T.R. On"
can be taken only at the output of the transformer-rectifier (T.R.).  DS439
and the transformer-rectifier input circuits are shown in Figure 1.

POTENTIAL IMPACT:

The present configuration of DS439 cannot monitor loss of input or output of
the transformer-rectifier.

RECOMMENDATION

1. Incorporate into applicable documentation that DS439 may not indicate the
   true "on-off" status of the hydraulic pump T.K., or

2. If a true "on" indication is desired, place DS439 or control of DS439 in
   the transformer-rectifier output circuit.

Figure 3.4.3, Page 1

THE *BOEING* AEROSPACE COMPANY - HOUSTON, TEXAS

AV-4275
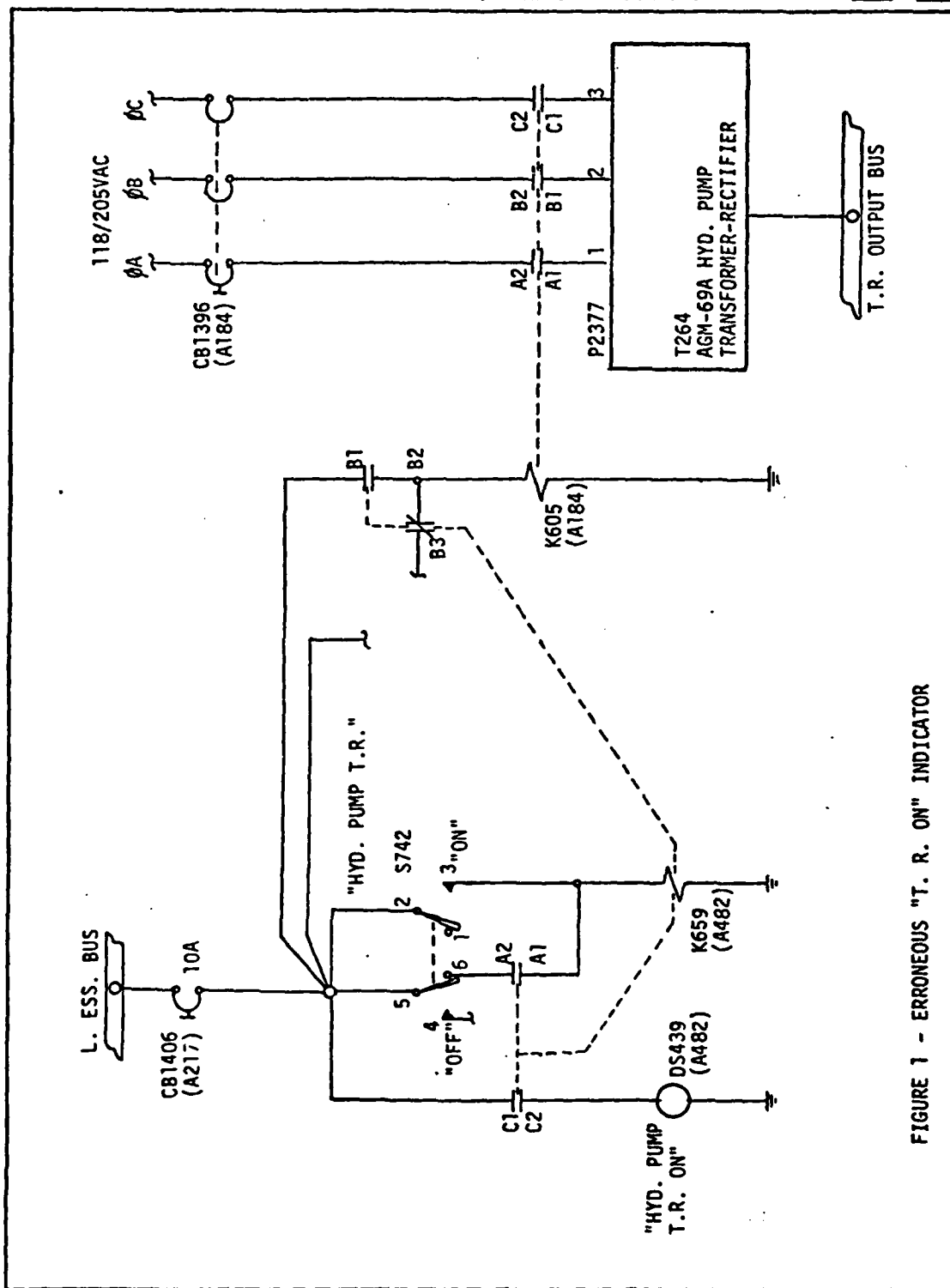
FIGURE 1 - ERRONEOUS "T. R. ON" INDICATOR

Figure 3.4.3, Page 2

# SNEAK CIRCUIT REPORT FB-111A-1

TITLE    Tail Arming Solenoid Cannot be Energized

DATE 9-17-75

ENGINEER M. Garnett

REFERENCES

1. T.O. 11N-T5055-2, Change 6, Station Program Unit, Figure 3-4.

2. T.O. 1F-111(B)A-2-11-1, Change 2, Figure 1-8, pg. 1-22

MODULE/EQUIPMENT

Pivot Pylon Conventional Station Program Unit/FB-111A

EXPLANATION

Reference 1 is excerpted in Figure 1. Note that no connection is made to pin 13 of relay K9. Normally open contact 3 of K9 connects to the "TAIL ARMING SOLENOID". Because of no connection to K9 pin 13, no means exists to energize the solenoid.

POTENTIAL IMPACT

Impossibility of tail arming a conventional weapon in this configuration.

RECOMMENDATION

Reference 2 implies that the dotted line connection shown in Figure 1 would resolve the problem.

Figure 3.4.4, Page 1
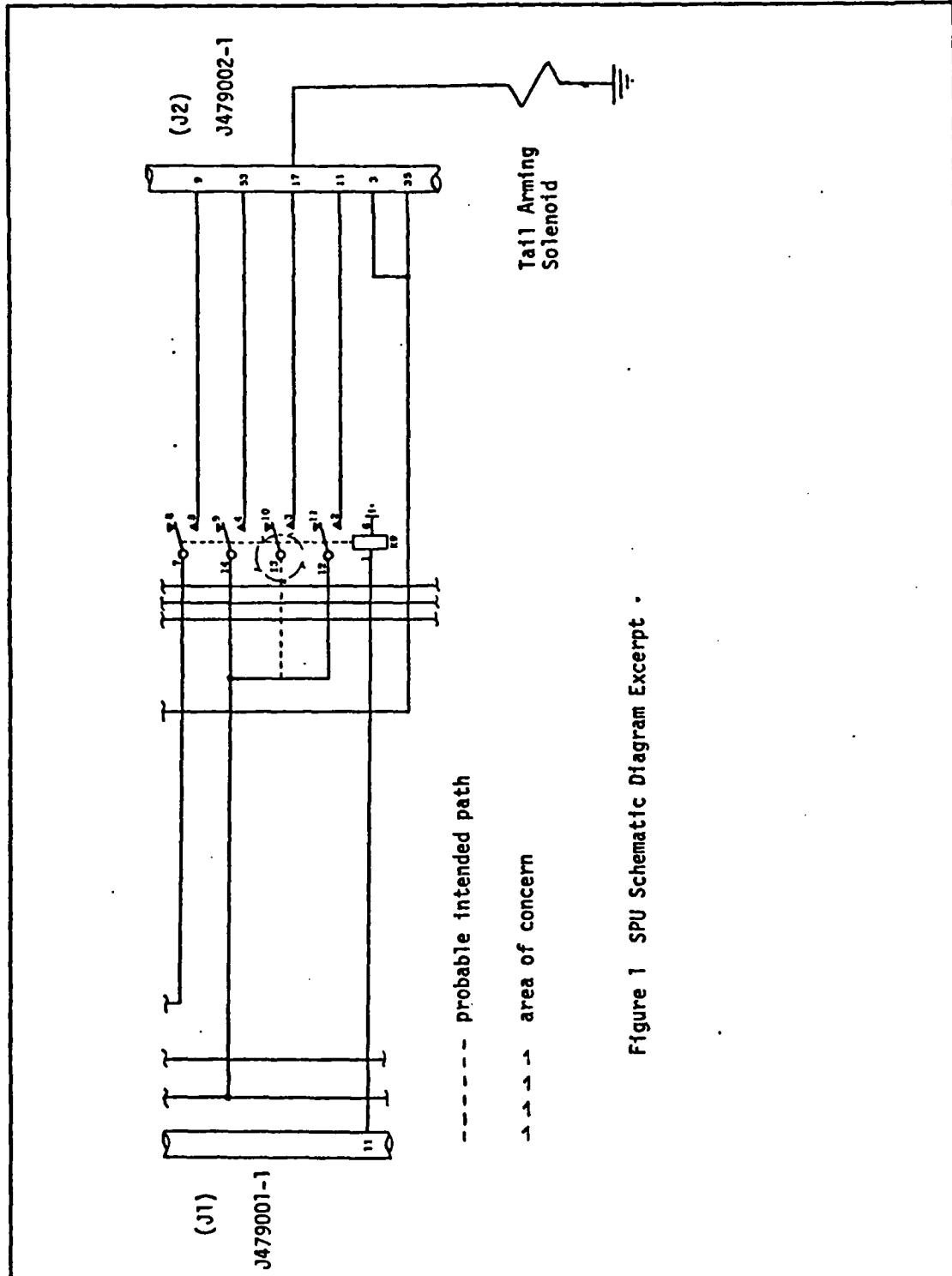
Figure 1  SPU Schematic Diagram Excerpt

Figure 3.4.4, Page 2

# SNEAK CIRCUIT REPORT FB-111A-2    PAGE 1 OF 2

TITLE    ESSENTIAL BUS TO MAIN BUS TIE

DATE ___10-6-75___

ENGINEER _H. Holt_

## REFERENCES

1. T.O. 11F9-2-3 Technical Manual, Overhaul Instructions, Programmer Electronic Command Signals, Figure 12-1.

2. T.O. 1F-111(B)A-2-14 Technical Manual, Organizational Maintenance, Wiring Diagrams, Figure 3-28A & 3-41A.

3. T.O. 11N-T5055-2 Technical Manual Intermediate Maintenance, Station Program Unit Figure 3-4.

## MODULE/EQUIPMENT

Weapon Release Circuitry/FB-111A

## EXPLANATION

Figure 1 shows that when the Release Program Unit (RPU) issues a MAU Fire 2 command and K3 (Stores Jett) in the conventional SPU is energized a bus to bus tie exists between the 28VDC Ess bus in the DC Power Panel and the 28VDC Main bus in Weapons Bay DC Power Panel. This is typical for all four pylon weapons stations.

## POTENTIAL IMPACT

When the bus to bus tie is made the 28VDC Ess bus can supply power to the 28VDC Main bus loads if the 28VDC Main bus is not powered for any reason. If the 28VDC Ess bus is at a higher potential than the 28VDC Main bus, CB5 in the DC Power Panel could trip causing loss of 28VDC power to the RPU MAU Fire circuits. Any fault that trips CB5 in the DC Power Panel will cause loss of both MAU Fire and 2 commands to all pivot pylons.

## RECOMMENDATION

Revise the aircraft wiring such that RPU connector J230004 pin 2 is supplied power from the 28VDC Main bus and remove the internal connection in the RPU that ties the wiring from J230004 pins 1 and 2 together, and reverse MAU Fire 1 and 2 outputs for weapon station 3 at the RPU.

Figure 3.4-5, Page 1

SNEAK CIRCUIT REPORT   FB-111A-2        PAGE 2 OF 2

28VDC ESS BUS                    28VDC MAIN BUS

PROG REL B                       WPN STA 3*

CB5                              CB12
20A                              35A

DC POWER                         WEAPONS BAY
PANEL                            DC POWER PANEL
304A1                            315A1

*CB29 WPN STA 4
CB13 WPN STA 5
CB30 WPN STA 6

4   2   3   1    J230004

RPU

STA 3            STA 3
R192             R191
      Q69              Q69**      **Q92 STA 4
                                    Q94 STA 5
                 MAU                Q72 STA 6
                 FIRE 2
                 (STA 3)
      MAU
FIRE 1 (STA 3)

PIVOT
EM1 · PYLON 3
Filter (TYP FOR
4,5 & 6)

SPU        SK 3
           STORES
           JETT

EJECTOR        PYL JETT      PYL JETT      CONV
CIRCUITRY      UNLOCK        SQUIB         WEAPON
                                           CIRCUITRY

FIGURE 1

Figure 3.4-5, Page 2

NOU-331

3-12
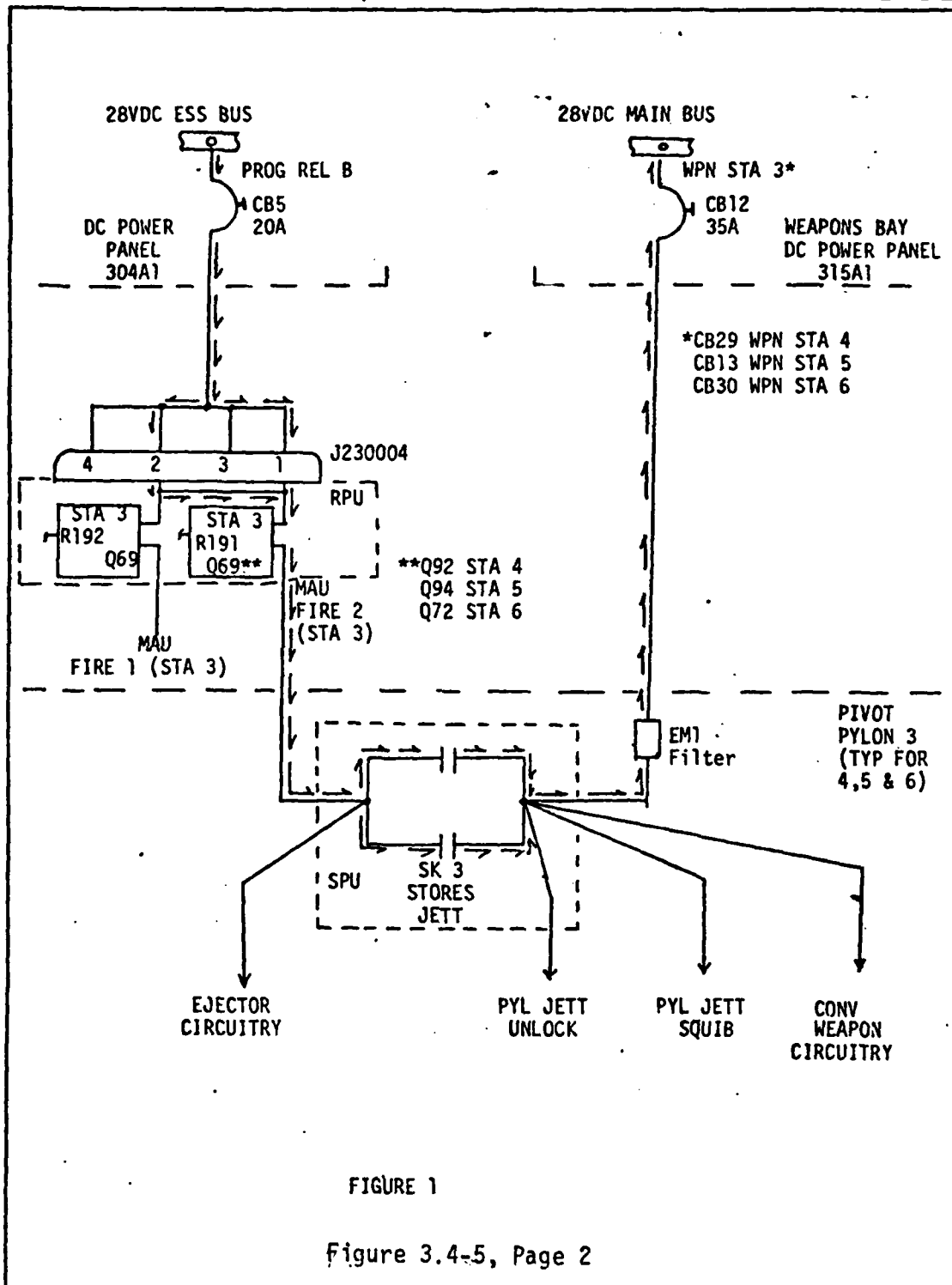
## 3.5    DESIGN CONCERN REPORTS

Two design concern reports (DCR's) were written describing areas of concern
in B-52G circuitry.  No DCR's resulted from the FB-111A analysis.  Copies
of the two DCR's are presented in Figures listed below.

| DCR Number | Subject | Figure |
|---|---|---|
| B-52G-1 | Unnecessary Components | 3.5-1 |
| -2 | Single Failure Point | 3.5-2 |

## DESIGN CONCERN REPORT   B-52G-1

TITLE    Unnecessary Components in Clip-In
         Subassembly and MB 3A Bomb Racks

DATE _____9-2-75_____

ENGINEER  M. Garnett

REFERENCES

1) USAF T.O. 11N-H5035-2, change 4, page 5-2, figure 5-1.

MODULE/EQUIPMENT

Clip-In Subassembly/B52-G

EXPLANATION

Figure 1 shows the forward right release schematic as it presently exists.  Note
that regardless of the state of salvo control relay K1, the lower and upper right
release solenoids will energize with the BRML switches closed.  A less complex
circuit shown in figure 2 deletes K1, uses a single set of lower right BRML switch
contacts, a single pair of lower right BOMB RACK RELEASE solenoid contacts, a single
set of upper right BRML switch contacts, and a single pair of upper right BOMB
RACK RELEASE solenoid contacts.  A similar situation exists for the forward left re-
lease schematic.

RECOMMENDATION

The configuration shown in figure 2 requires fewer and less complex components.
Removal of the salvo control relay K1 saves parts and improves reliability.  It may
be desired however, to leave the BRML switches and RELEASE solenoid contacts as is
for redundancy.

Figure 3.5.1, Page 1

SWITCHED 24VDC

SALVO CONTROL RLY
K1 — A2        A2
A1             A3

LOWER RIGHT BRML
SWITCH

LOWER RIGHT
BMB RK
RELEASE
SOLENOID

UPPER RIGHT BRML
SWITCH

OPEN                    OPEN

UPPER RIGHT
BMB RK
RELEASE SOLENOID

Figure 1 - Right Bomb Release Circuit

HOU-331

Figure 3.5.1, Page 2

DESIGN CONCERN REPORT    B-52G-1          PAGE 3  OF 3

SWITCHED 24VDC

LOWER RIGHT BRML SWITCH

LOWER RIGHT
BMB RK
RELEASE SOLENOID

UPPER RIGHT BRML SWITCH

UPPER RIGHT
BMB RK
RELEASE SOLENOID

OPEN
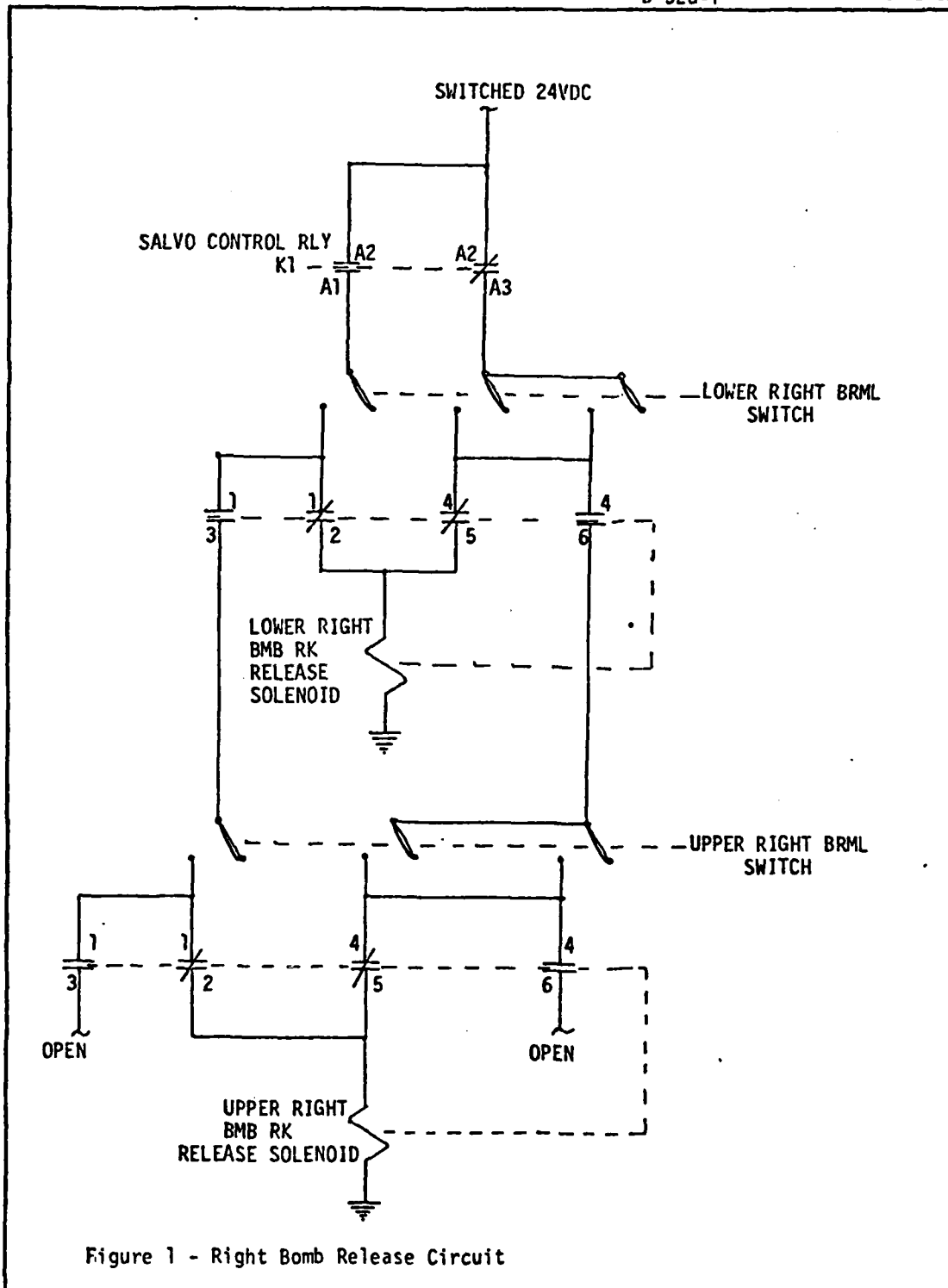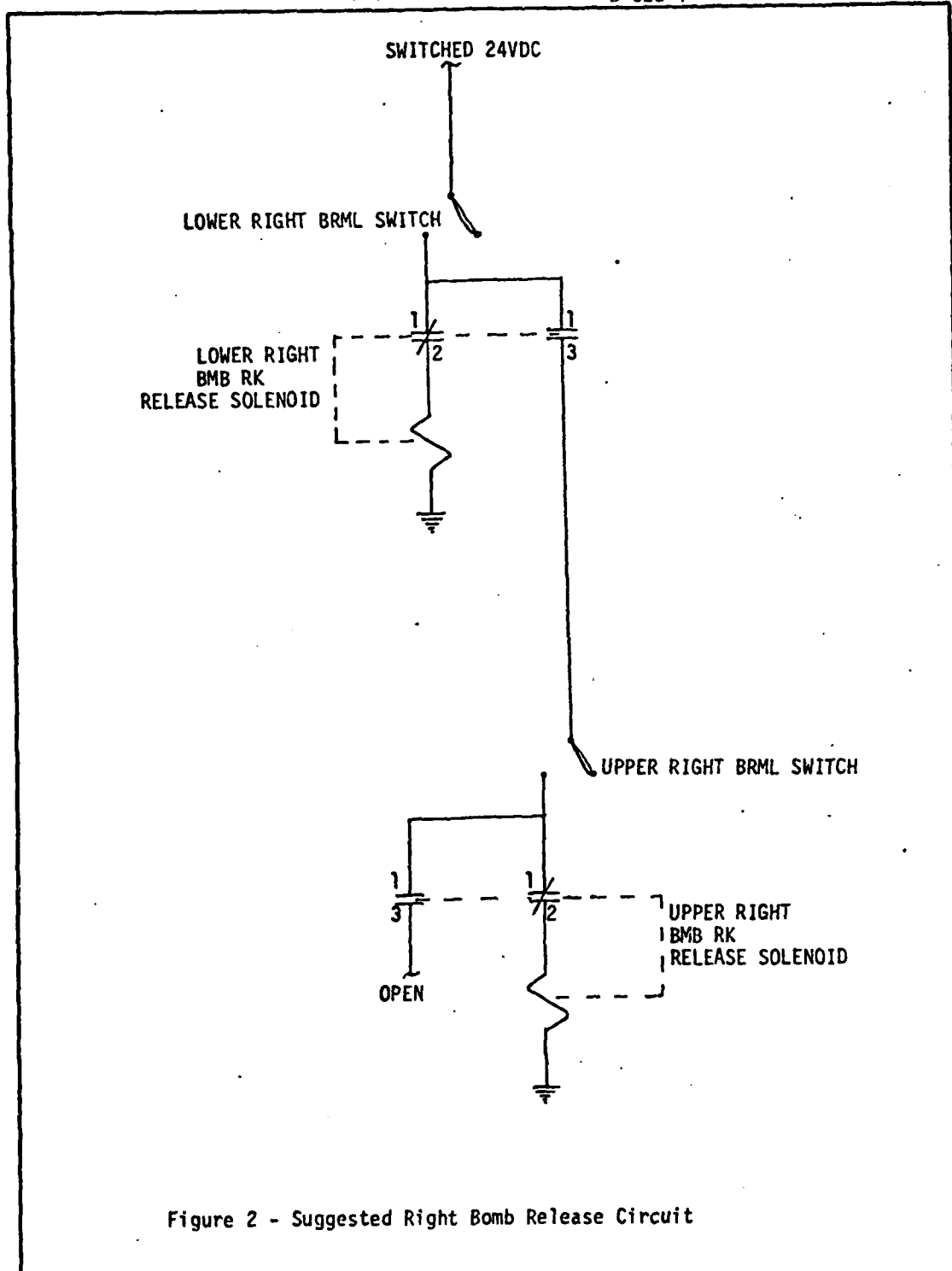
Figure 2 - Suggested Right Bomb Release Circuit

HOU-331

Figure 3.5.1, Page 3

# DESIGN CONCERN REPORT B-52G-2

TITLE    Single Failure Point Ties Missile Critical
         & Non-Critical Electronic Power

DATE ___9-3-75___

ENGINEER M. Garnett

REFERENCES

1) USAF T.O. 11LA12-2-3, page 5-40, figure 5-9, Schematic Diagram Relay Assembly
2) USAF T.O. 16W6-19-2, change 3, page 5-15, figure 5-7, Pylon Electrical Schematic

MODULE/EQUIPMENT

B-52G/AGM-69A

EXPLANATION

As shown in figure 1, pins Y and M on the missile connector (J9 for MSL 1, etc)
are connected together in the relay assembly, reference 1.  This connection ties
the "ELECTRONIC POWER (NON-CRITICAL)" and the "ELECTRONIC POWER (CRITICAL)"
supplied to the missiles per reference 2.  A failure on the "NON-CRITICAL" bus will
result in the loss of both "CRITICAL" and "NON-CRITICAL" ELECTRONIC POWER.

RECOMMENDATION

Supply separate paths including circuit breakers and relay switching for "CRITICAL"
and "NON-CRITICAL" ELECTRONIC POWER or delete the distinction.

Figure 3.5.2, Page 1

THE *BOEING* AEROSPACE COMPANY - HOUSTON, TEXAS

D2-118576 -1
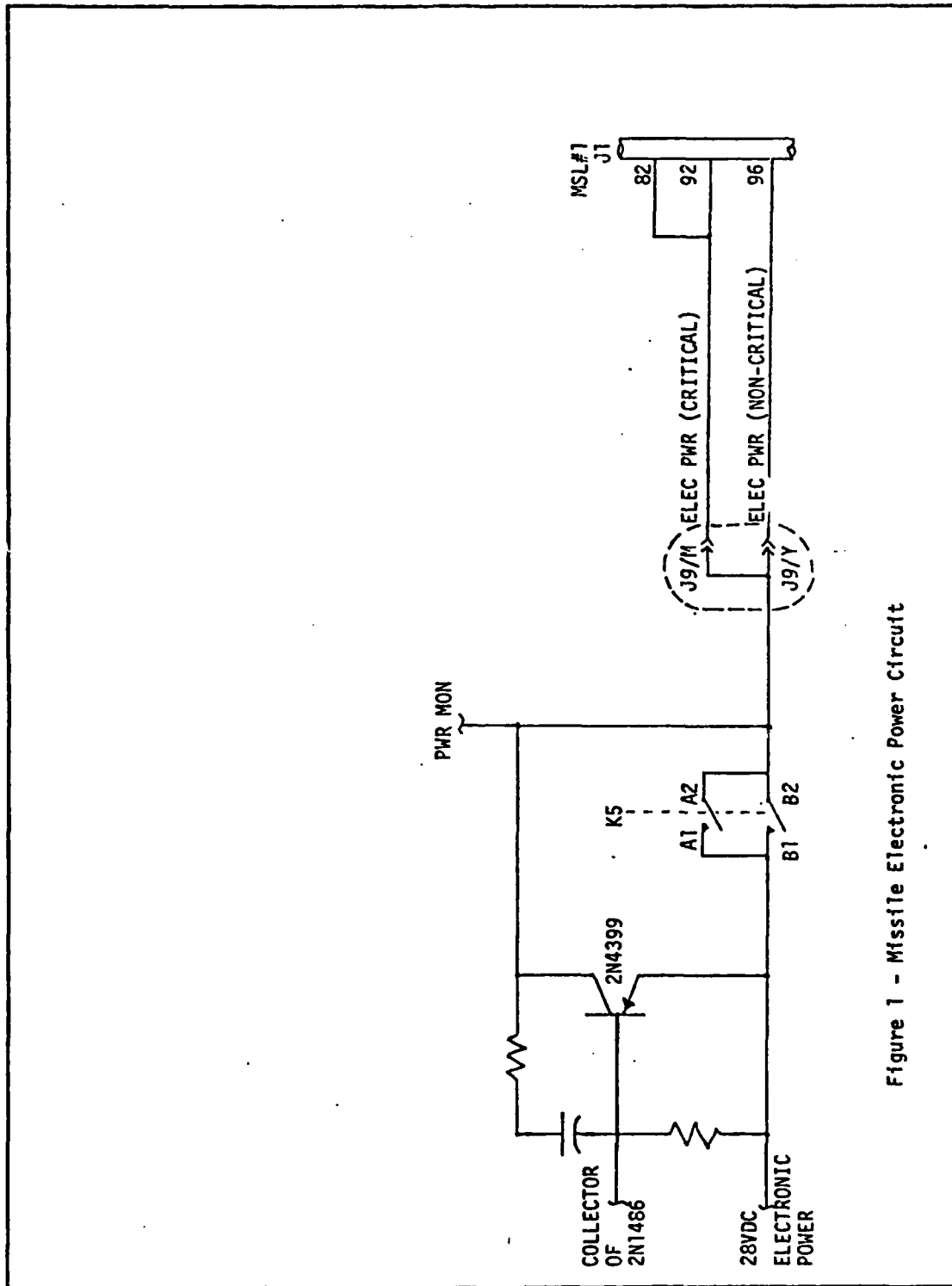
Figure 1 - Missile Electronic Power Circuit

Figure 3.5.2, Page 2

3-18

## 3.6    DRAWING ERROR REPORTS

A total of six drawing error reports (DER's) were written during the analysis. One DER resulted from the B-52G analysis, and five resulted from the FB-111A analysis.  Copies of the DER's are presented in Figures listed below.

| DER Number | Subject | Figure |
|---|---|---|
| B-52G-1 | T.O. 1B-52G-2-23, p. A8.14, Change 10 | 3.6-1 |
| FB-111A-1 | T.O. 1F-111(B)A-2-14, p. 3-246H, Change 5 | 3.6-2 |
| -2 | T.O. 1F-111(B)A-2-145-1, p. 3-244, Change 5 | 3.6-3 |
| -3 | T.O. 1F-111(B) A-214, p. 3-246 E, Change 5-S10 | 3.6-4 |
| -4 | T.O. 16W6-23-2, p. 2-69, Change 9 | 3.6-5 |
| -5 | T.O. 1F-111(B)A-2-14, p. 3-762A, Change 10 | 3.6-6 |

# DRAWING ERROR REPORT B-52G-1

TO:                                          PROJECT:

| DOCUMENT NO. | REFERENCE DESIGNATOR | SUBSYSTEM |
|---|---|---|
| T.O. 1B-52G-2-23, A8.14 Change 10 | A217 | POWER |

UNIT NOMENCLATURE

     LH FWD DC LOAD BOX

DISCREPANCY:

    CB550 has a rating of 5A shown on page A8.14 of T.O. 1B-52G-2-23. The part number shown in the index is BAC-C18J-15 which is a 15A rating.

ASSUMED CORRECTION:

    Change the rating shown on page A8.14 to 15A.

REPORTED BY ___J. B. Campbell_____ DATE _8-19-75_____

SNEAK CIRCUIT
GROUP ACTION BY____J. B. Campbell _____ DATE _8-19-75_____

CONTACT NAME _____ DATE _____

CONTRACTOR CONCURRENCE BY_____ DATE _____

Figure 3.6.1

HOU-227   **_BOEING_** COMPANY   SPACE DIVISION HOUSTON

# DRAWING ERROR REPORT FB-111A-1

| TO: | PROJECT: FB-111A | |
|---|---|---|
| DOCUMENT NO. | REFERENCE DESIGNATOR | SUBSYSTEM |
| T.O. 1F-111(B)A-2-14 | RPU (A2) | |

| UNIT NOMENCLATURE |
|---|
| RELEASE PROGRAM UNIT |

**DISCREPANCY:**

Figure 3-28A, Sheet 9; Page 3-246H, Change 5

The following discrepancies exist in that portion of the circuit shown on the attached sheet:

1. Plug P13 is labeled incorrectly
2. Receptacle J23004 is labeled incorrectly
3. The function of P13-2,3,4 are shown incorrectly
4. Wire number A2403B12 is used twice

**ASSUMED CORRECTION:**

1. P13 will be labeled P230004.
2. The RPU receptacle will be labeled J230004.
3. All inputs to the RPU will be labeled ESS BUS.
4. One wire will be renumbered.

REPORTED BY ___P. Stokes _P Stokes_____ DATE __9-22-75___

SNEAK CIRCUIT
GROUP ACTION BY _Julius B. Campbell_____ DATE _9-23-75_____

CONTACT NAME _____ DATE _____

CONTRACTOR CONCURRENCE BY_____ DATE _____

Figure 3.6.2, Page 1

Figure 1   Release Program Unit

Figure 3.6.2, Page 2

## DRAWING ERROR REPORT FB-111A-2

TO: _____ PROJECT: FB-111A

| DOCUMENT NO. | REFERENCE DESIGNATOR | SUBSYSTEM |
|---|---|---|
| USAF T.O. 1F-111(B)A-2-145-1, Change 5 | SPU L and R | |

| UNIT NOMENCLATURE |
|---|
| Station Program Unit, part number 9346-8479-1 |

DISCREPANCY:

On Sheet 3-244, Figure 3-28 shows modules A3 and A4 which are the left and right SPU's. Note that J479002/28 is referenced to 12D2247. At this reference no J479002/28 can be located but J479002/41 (unwired on the document in question) is present. See Figure 1. It appears that J479002 pins 28 and 41 have been reversed.

ASSUMED CORRECTION:

Using USAF T.O. 1F-111(B)A-2-11-1, sheet 1-26, change 2 as supporting documentation, J479002/28 should be unwired and J479002/41 should be shown connected and referenced to 12D2247 in pin 28's place. Figure 2 excerpts the SPU on the aforementioned T.O.

REPORTED BY _____ M. Garnett _____ DATE __ 9-23-75 _____

SNEAK CIRCUIT
GROUP ACTION BY _Juliue B Campbell_____ DATE _9-24-75_____

CONTACT NAME _____ DATE _____

CONTRACTOR CONCURRENCE BY_____DATE_____

Figure 3.6.3, Page 1

Figure 2

Figure 1

↑ area of concern

HOU-331

Figure 3.6.3, Page 2

3-24

## DRAWING ERROR REPORT FB-111A-3

TO:                                                    PROJECT:    FB-111A

| DOCUMENT NO. | REFERENCE DESIGNATOR | SUBSYSTEM |
|---|---|---|
| T.O. 1F-111(B)A-2-14 | 003S10 | |

UNIT NOMENCLATURE

   EXT STORES JETTISON

DISCREPANCY:

   Figure 3-28A, Sheet 6, Page 3-246E, Change 5-S10 is labeled "EMER JETTISON SW".
   On the jettison panel, S10 is labeled "EXT STORES JETTISON"
   (Ref. T.O. 1F-111(B)A-2-11-1, Change 4, page 1-3 and 1-23)

ASSUMED CORRECTION:

   Change figure 3-28A, Sheet 6 of T.O. 1F-111(B)A-2-14 to read "EXT STORES JETTISON"
   so that panel nomenclature and schematic nomenclature will agree.

REPORTED BY _____ Jim Verges _____ DATE ____ 9-24-75 _____

SNEAK CIRCUIT
GROUP ACTION BY _J. Burl Campbell_____ DATE __10-7-75_____

CONTACT NAME _____ DATE _____

CONTRACTOR CONCURRENCE BY_____ DATE _____

Figure 3.6-4

## SNEAK CIRCUIT DRAWING ERROR REPORT FB-111A-4

| TO: | PROJECT: | |
|---|---|---|
| **DOCUMENT NO.**<br>T.O. 16W6-23-2, 2-69, Change 9 | **REFERENCE DESIGNATOR**<br>Pivot Pylon | **SUBSYSTEM**<br>Monitor &<br>Control |

**UNIT NOMENCLATURE**

Conventional Weapon Station Program Unit

**DISCREPANCY:**

T.O. 16W6-23-2 shows an electrical connection between Pins 1, 20, 21 of connector P47900-1.

T.O. 1F-111(B)A-2-14 and T.O. 1F-111(B)A-2-11-1 show an electrical connection between Pins 1, 20, 22 of connector P479001-1.

**ASSUMED CORRECTION:**

T.O. 16W6-23-2 should be changed to show electrical connection between Pins 1, 20, 22 of connector P479001-1.

REPORTED BY _____ H. Holt  2. _____ DATE __ 10-3-75 __

SNEAK CIRCUIT
GROUP ACTION BY __ H. Holt _____ DATE __ 10-3-75 __

CONTACT NAME _____ DATE _____

CONTRACTOR CONCURRENCE BY_____ DATE _____

Figure 3.6-5

HOU-717 -1    THE *BOEING* COMPANY   SPACE DIVISION HOUSTON

# SNEAK CIRCUIT DRAWING ERROR REPORT FB-111A-5

**TO:**  **PROJECT:**

| DOCUMENT NO. | REFERENCE DESIGNATOR | SUBSYSTEM Weapon Release |
|---|---|---|
| T.O. 1F-111(B)A-2-14, Change 10 | 304A1 | |

**UNIT NOMENCLATURE**

Program Release B Circuit Breaker

**DISCREPANCY:**

T.O. 1F-111(B)A-2-14, Page 3-762A, Change 10 shows the Program Release B circuit breaker between wire A2403A12 and the essential bus rated at 5 amps.

T.O. 1F-111(B)A-2-14, Page 3-246H, Change 5, shows the Program Release B circuit breaker between wire A2403A12 and the essential bus rated at 20 amps.

**ASSUMED CORRECTION:**

T.O. 1F-111(B)A-2-14, Page 3-762A should be changed to show the Program Release B circuit breaker (between wire A2403A12 and essential bus) rated at 20 amps.

REPORTED BY _____ H. Holt _____ DATE __10-3-75__

SNEAK CIRCUIT GROUP ACTION BY __ H. Holt __ DATE __10-3-75__

CONTACT NAME _____ DATE _____
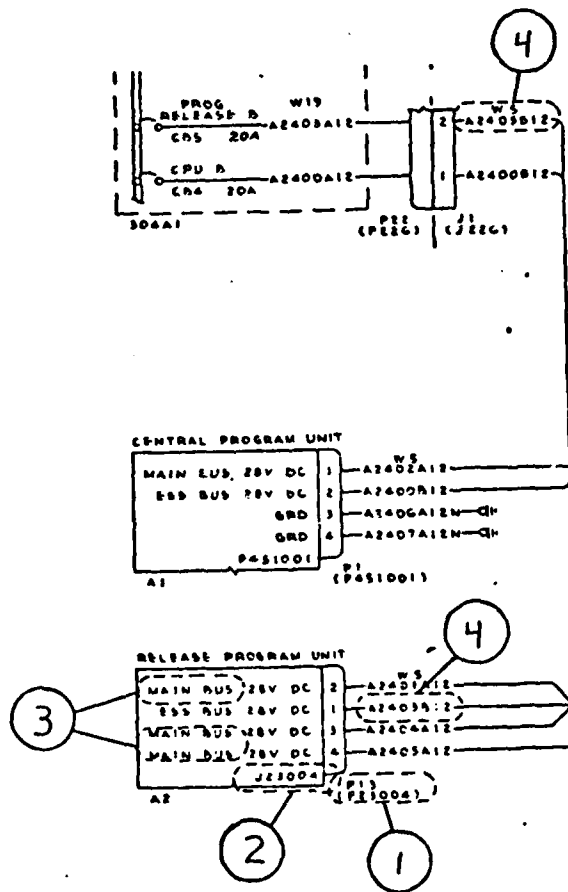
CONTRACTOR CONCURRENCE BY_____ DATE _____

Figure 3.6-6

## 4.0    POWER AND LOAD ANALYSIS

Boeing performed a power and load analysis of B-52 and FB-111 aircraft
monitor and control (AMAC) circuitry to the nuclear weapon interfaces.  Normal
power and load analysis included direct and indirect interface circuits.
Circuits adjacent to exposed nuclear weapon system circuitry sharing common
cables, connectors and components were included in the fault analysis.
The B-52 and FB-111 subsections are designed to stand alone in the event
that they are separated from the rest of the report.  The following diagram
shows how the power and load analysis subsections are organized.

POWER AND LOAD ANALYSIS
SECTION 4

POWER AND LOAD ANALYSIS
B-52G Subsection 4.1

GENERAL

4.1.1 Summary
4.1.2 Condition
4.1.3 Circuit Ident.
4.1.4 Normal Envir.
4.1.5 Abnormal Envir.

Circuit Analysis Packages
4.1.6 Gravity Weapon Interfaces
4.1.7 AGM-69A Interfaces

ACCIDENT ANALYSIS
Subsection 4.3

4.3.1 Purpose
4.3.2 Source Data
4.3.3 Damage Analysis
4.3.4 Findings
4.3.5 Conclusions

POWER AND LOAD ANALYSIS
FB-111A Subsection 4.2

GENERAL

4.2.1 Summary
4.2.2 Conditions
4.2.3 Circuit Ident.
4.2.4 Normal Envir.
4.2.5 Abnormal Envir.

Circuit Analysis Packages
4.2.6 Pivot/Weapons Bay Gravity
       Weapon Interfaces

## 4.1     POWER AND LOAD ANALYSIS - B-52G

This section describes the power and load analysis of the B-52G monitor and
control (AMAC) circuits leading to gravity weapons loaded on the forward bomb
bay multiple carriage clip-in assembly and to AGM-69A missiles on the left pylon
and the launcher in the aft bomb bay.  Figures 4.1-A and 4.1-B are simplified
schematic diagrams of gravity weapon circuits and AGM-69A arming circuits.
Numbers opposite the AMAC connector pins refer to analysis packages in Sections
4.1.6 and 4.1.7 of this report.

### 4.1.1     Summary

The power and load analysis was performed on groups of interface circuits
identified by sneak circuit network trees.  Results are summarized in Table
4.1-A.

### 4.1.2     Conditions

The study was made according to the following ground-ruled conditions:

o     Interfaces with gravity bombs are the connectors shown in the
      aircraft wiring diagrams.

o     Interfaces with SRAM are the aircraft connectors to the SRAM
      missile.  Internal SRAM missile circuits were excluded.

o     Aircraft circuits for SRAM guidance were excluded.

o     One SRAM weapons bay installation and one SRAM pylon station was
      analyzed in depth for the B-52G.  The other similar SRAM installa-
      tions were analyzed for impacts of detail differences.

o     Analyses of abnormal environments considered only one fault at a
      time.

o     Wiring faults within aircraft wiring harnesses were limited to
      those within shared cables and connectors.  Cable-to-cable and
      bundle-to-bundle wiring faults were excluded.

o     Release circuits were not included as nuclear weapon interface
      circuits during load analysis for abnormal environments.

o     Short circuits in terminals and faults internal to components were
      considered only in the worst-case abnormal environment analysis
      for each model.

TABLE 4.1-A  Power and Load Analysis Results - B-52/Gravity Weapons Interface
(Sheet 1 of 2)

Note: Power is DC unless otherwise noted. AC current is 400 Hz unless otherwise noted.

| WEAPON INTERFACE | | | ENVIRONMENT ANALYSIS RESULTS | | | | | | ANALYSIS PACKAGE |
| DESIGNATOR | Pin | FUNCTION | NORMAL | | | ABNORMAL – WORST CASE | | | |
| | | | V | I | t | V | I | t | Section 4.1.6 |
|---|---|---|---|---|---|---|---|---|---|
| A114, J11, J12, J13 and J14  — Forward Bomb Bay Clip-In Connectors | A | IFC SAFING PWR | 24V | 75A | 3.5s | 24V | 109A | 1.4s | 4.1.6.7 |
| | B | TESTER SW GND | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.7 |
| | C | TESTER SW OFF/SAFE | 0 | 0 | – | 24V | 110A | 1.1s | 4.1.6.4 |
| | D | TESTER SW AIR | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.7 |
| | E | IFC SAFING PWR | 24V | 131A | 1.0s | 24V | 211A | .8s | 4.1.6.7 |
| | F | TESTER SW SAFE | 0 | 0 | – | 24V | 109A | 1.2s | 4.1.6.6 |
| | G | INFLIGHT TEST | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.7 |
| | H | TESTER SW, READY | 0 | 0 | – | 24V | 150A | .8s | 4.1.6.6 |
| | J | TESTER SW, AIR | 0 | 0 | – | 24V | 109A | 1.2s | 4.1.6.6 |
| | L | INFLIGHT TEST | 0 | 0 | – | 24V | 152A | | 4.1.6.7 |
| | O | WPN GROUND | GROUND | | | | | | |
| | P | IFC SAFING PWR | 24V | 152A | 0.8s | 24V | 258A | .8s | 4.1.6.7 |
| | R | INFLIGHT TEST | 0 | | – | 24V | 152A | .8s | 4.1.6.7 |
| | S | WPN GROUND | GROUND | | | | | | |
| J11,12T | | FWD IFI PWR, 25A | 0 | 0 | – | 28V | 1170A | .8s | 4.1.6.3 (LH WPNS) |
| J13,14T | | AFT IFI PWR, 25A | 0 | 0 | – | 28V | 1000A | .8s | 4.1.6.2 (RH WPNS) |
| | U | WPN GROUND | GROUND | | | | | | |
| | V | WPN GROUND | GROUND | | | | | | |
| | W | FWD IFI PWR, 15A | 0 | 0 | – | 28V | 800A | .8s | 4.1.6.3 |
| | X | (OPEN) | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.7 |
| | Y | FWD IFI PWR, 15A | 0 | 0 | – | 28V | 800A | .8s | 4.1.6.3 |
| | Z | TESTER SW, AIR | 0 | 0 | – | 24V | 110A | 1.1s | 4.1.6.4 |
| | a | TESTER SW, GND | 0 | 0 | – | 24V | 110A | 1.1s | 4.1.6.4 |
| | c | TESTER SW, GND | 0 | 0 | – | 24V | 109A | 1.2s | 4.1.6.6 |
| | d | IFC RELAY (FWD) | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.1 |
| | f | TESTER SW, READY | 0 | 0 | – | 24V | 218A | .8s | 4.1.6.4 |
| | h | FWD BOMB BAY SAFE | 0 | 0 | – | 24V | 152A | .8s | 4.1.6.5 |

TABLE 4.1A   Power and Load Analysis Results - B-52/AGM-69 Interfaces
(Sheet 2 of 2)

| DESIGNATOR | WEAPON INTERFACE / FUNCTION | ENVIRONMENT ANALYSIS RESULTS | | | | | | ANALYSIS PACKAGE |
| | | NORMAL | | | ABNORMAL - WORST CASE | | | Section 4.1.7 |
| | | V | I | t | V | I | t | |
| J1 | Missile Connector | | | | | | | |
| Pin 2 | BATTERY ACTIVATE | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .125s | 4.1.7.4 |
| 10 | ACCUMULATOR ACT. | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .125s | 4.1.7.4 |
| 20 | SAF CLASS III A CMD. | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .13s | 4.1.7.8 |
| 26 | FIN UNLOCK | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.4 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .125s | 4.1.7.4 |
| 57 | PROPULSION SAFE | | | | | | | |
| | PYLON | 0V | 0A | -- | 28V | 1115A | 1.5s | 4.1.7.5 |
| | LAUNCHER | 0V | 0A | -- | 28V | 411A | 2.0s | 4.1.7.3 |
| 60 | SAF CLASS III B CMD. | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.8 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .13s | 4.1.7.8 |
| 82, 92, 96 | MISSILE ELECTRONIC POWER | | | | | | | |
| | PYLON SYS. ON | 28V | 254A | .45s | 28V | 1115A | 1.5s | 4.1.7.6 |
| | SYS. OFF | 0V | 0A | -- | 28V | 1115A | 1.5s | 4.1.7.6 |
| | LAUNCHER SYS. ON | 28V | 368A | .2s | 28V | 1220A | 1.5s | 4.1.7.2 |
| | SYS. OFF | 0V | 0A | -- | 28V | 1220A | 1.5s | 4.1.7.2 |
| 97 | SAF PREARM CMD. | | | | | | | |
| | PYLON | 0V | 0A | -- | 118VAC | 983A | .125s | 4.1.7.1 |
| | LAUNCHER | 0V | 0A | -- | 118VAC | 900A | .13s | 4.1.7.1 |
| J1 | Ejector Connector | | | | | | | |
| Pin r | ARM SOLENOID | | | | | | | |
| | PYLON | 0V | 0A | -- | 27V | 37A | 1.1s | 4.1.7.7 |
| | LAUNCHER | 0V | 0A | -- | 27V | 54A | 1.1s | 4.1.7.7 |

### 4.1.3    Identification of Circuits

The analysis used Air Force technical manuals and other source documents to identify the interface circuits.  The gravity bomb interfaces are shown  in T.O. 11N-H5035-2, Figure 5-2, Change 4.  (Reproduced in Figure 4.1-A of this report).  The AMAC circuitry to the gravity weapons is shown in Figure 4.1-B, which is a reproduction of T.O. 1B-52B-2-31, Figure 3-10, Change 33.  Analysis package numbers are shown opposite to the corresponding AMAC connector pins. AGM-69A missile interface is shown in Figure 4.1-C.  Pertinent arming circuits are shown in Figure 4.1-D.  The analysis used sneak circuit network trees and other source documents to identify adjacent and interrelated circuits for fault analysis.  The applicable network trees are reproduced in the analysis packages.

### 4.1.4    Normal Environment

Power capability of the interfacing circuits was calculated by determining open circuit voltage and short circuit current at the weapon interfaces with the circuits grounded at that point.

### 4.1.5    Abnormal Environments

Each network tree was analyzed for postulated faults.  Postulated faults were identified by numbered circles.  The worst case for each interfacing circuit was identified and open circuit voltage, short circuit current and the duration of current flow was determined.

Several of the faults postulated receive power through the DCU-9/A Tester or SWK Box.  Power from these sources can occur only twice during a mission according to T.O. 1B-52G-1, Radar Navigators Checklist (Nuclear), once during the Interior Inspection Checklist, before takeoff, and during the Before Descent Checklist.  Power paths other than those through DCU-9/A Tester or SWK Box were used to determine worst case conditions whenever they existed. The reasons are that exposure to damage time during testing is minimal, and testing does not occur during landing, takeoff and air refueling when risk to damage is highest.

Figure 4.1-A Gravity Bomb Weapon Interfaces
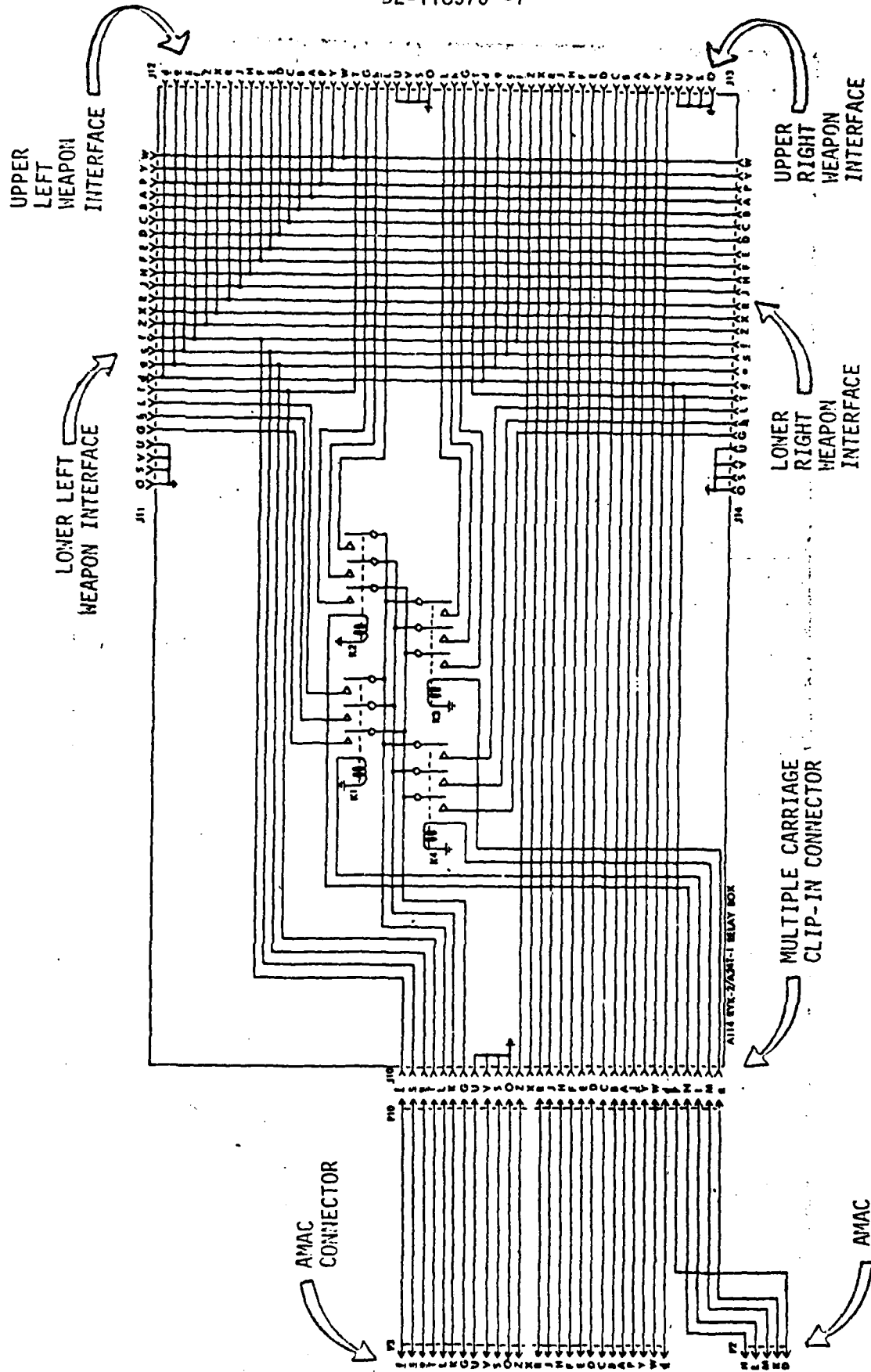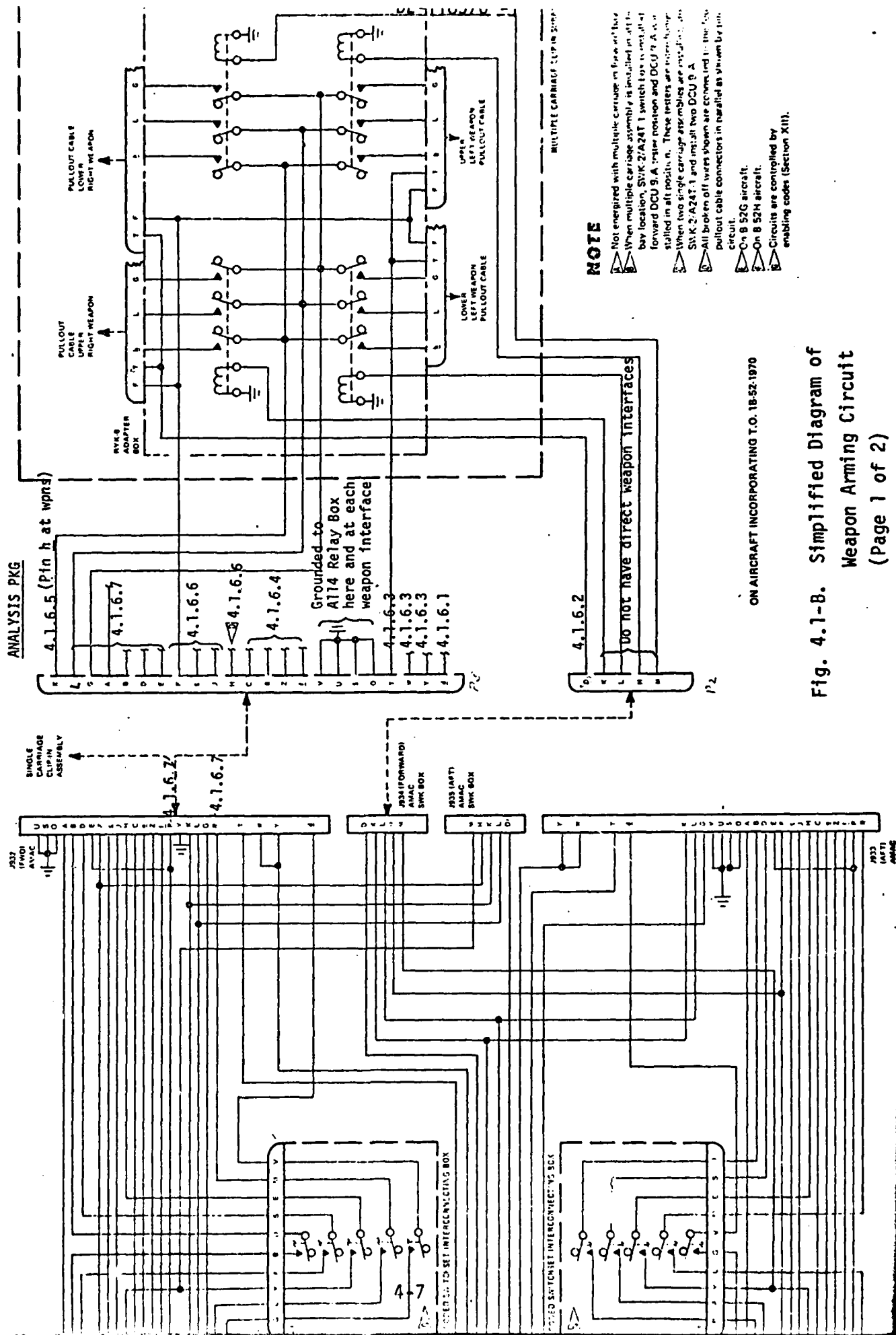
Fig. 4.1-B. Simplified Diagram of Weapon Arming Circuit (Page 1 of 2)
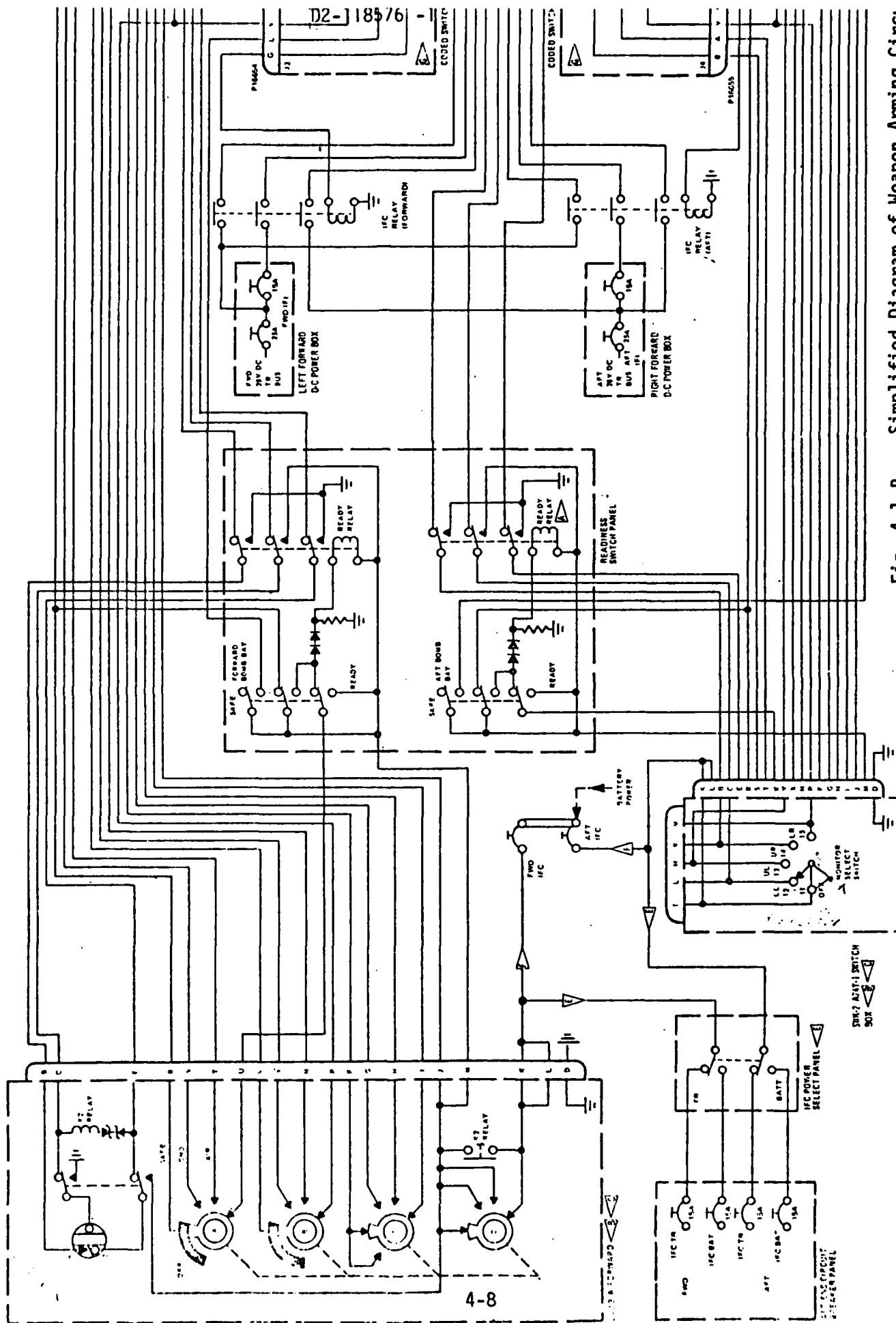
Fig. 4.1-B. Simplified Diagram of Weapon Arming Circuit
(Page 2 of 2)

Figure 3-10. Weapon Arming Simplified Circuit (B-52G and H Aircraft) (Sheet 2 of 2)

MISSILE NO. 1

P32 J1



| Signal | Pin |
|---|---|
| BATTERY ACTIVATE | 2 |
| BATTERY ACTIVATE RETURN | 1 |
| ACCUMULATOR ACTIVATE | 10 |
| ACCUMULATOR ACTIVATE RETURN | 4 |
| FIN UNLOCK | 26 |
| FIN UNLOCK RETURN | 25 |
| C/D SEA ARM MONITOR | 75 |
| C/D RECEIVER SIGNAL PRESENT MONITOR | 76 |
| SPARE NO. 1 | 50 |
| APPLY BATTERY POWER | 40 |
| RELAY COMMON | 30 |
| REMOVE BATTERY POWER | 29 |
| SAF PREARM COMMAND | 97 |
| SAF SAFE COMMAND | 59 |
| SAF CLASS III A COMMAND | 20 |
| SAF CLASS III B COMMAND | 60 |
| SAF SIGNAL COMMON | 88 |
| STORE PRESENT | 84 |
| SPARE NO. 3 | 21 |
| 4 | 77 |
| 5 | 78 |
| SPARE NO. 6 | 74 |
| MISSILE IN DATA | 44 |
| MISSILE IN DATA COMP | 34 |
| MISSILE OUT DATA | 45 |
| MISSILE OUT DATA COMP | 35 |
| MISSILE TIMING | 47 |
| MISSILE TIMING COMP | 48 |
| BUFFER READY NO. 1 | 23 |
| BUFFER READY NO. 1 COMP | 14 |
| FINE ALIGN COMMAND | 22 |
| FINE ALIGN COMMAND COMP | 13 |
| COARSE ALIGN COMMAND | 46 |
| COARSE ALIGN COMMAND COMP | 36 |
| BUFFER READY NO. 2 | 43 |
| BUFFER READY NO. 2 COMP | 33 |
| BUFFER READY NO. 3 | 7 |
| BUFFER READY NO. 3 COMP | 6 |
| ARM TIMING | 17 |
| ARM TIMING COMP | 16 |
| ARM IN DATA | 9 |
| ARM IN DATA COMP | 8 |

| Signal | Pin |
|---|---|
| COLD PLATE TEMP HI | 72 |
| COLD PLATE TEMP LO | 83 |
| PROPULSION SAFE/ARM MONITOR | 69 |
| PROPULSION SAFE/ARM MONITOR RETURN | 58 |
| PROPELLENT TEMP MONITOR | 39 |
| PROPELLENT TEMP MONITOR RETURN | 28 |
| MISSILE TEST COMMAND | 24 |
| HYDRAULIC PRESSURE MONITOR | 31 |
| ALTIMETER GO/NO GO | 32 |
| GUIDANCE SIGNAL COMMON | 70 |
| PSEUDO STEER-YAW | 54 |
| PSEUDO STEER-PITCH | 41 |
| PSEUDO STEER-ROLL | 55 |
| FIN POSITION NO. 1 | 38 |
| FIN POSITION NO. 2 | 37 |
| FIN POSITION NO. 3 | 27 |
| VALVE CURRENT NO. 1 | 19 |
| VALVE CURRENT NO. 2 | 18 |
| VALVE CURRENT NO. 3 | 11 |
| ARM GO/NO GO | 62 |
| ARM POWER ON-OFF | 98 |
| SAF GO/NO GO MONITOR | 52 |
| SAF SAFE MONITOR | 49 |
| SAF PREARM MONITOR | 61 |
| SAF CLASS III MONITOR | 71 |
| SPARE | 66 |
| HYDRAULIC POWER | 100 |
| HYDRAULIC POWER RETURN | 99 |
| MISSILE HEATER POWER NO. 1 | 101 |
| RETURN | 89 |
| NO. 2 | 90 |
| MISSILE HEATER POWER NO. 3 | 91 |
| ELECTRONIC POWER (CRITICAL) | 82 |
| | 92 |
| | 94 |
| ELECTRONIC POWER RETURN | 93 |
| | 56 |
| ELECTRONIC POWER (NON-CRITICAL) | 96 |
| INSTRUMENTATION PWR | 51 |
| PWR RETURN | 63 |
| MONITOR (REFERENCE) | 65 |
| PWR ON MONITOR-CARRIER | 85 |
| TRANSFER-MISSILE | 80 |
| OFF MONITOR-CARRIER | 53 |
| INSTRUMENTATION PWR TRANSFER-CARRIER | 81 |
| SPARE NO. 7 | 73 |
| PROPULSION SAFE | 57 |
| SPARE NO. 8 | 68 |

Figure 4.1-C  AGM-69A Missile Interface

Figure 4.1-D AGM-69A Simplified Schematic – Arming Circuits

D2-118576 -1

*ANALYSIS PACKAGE NO.
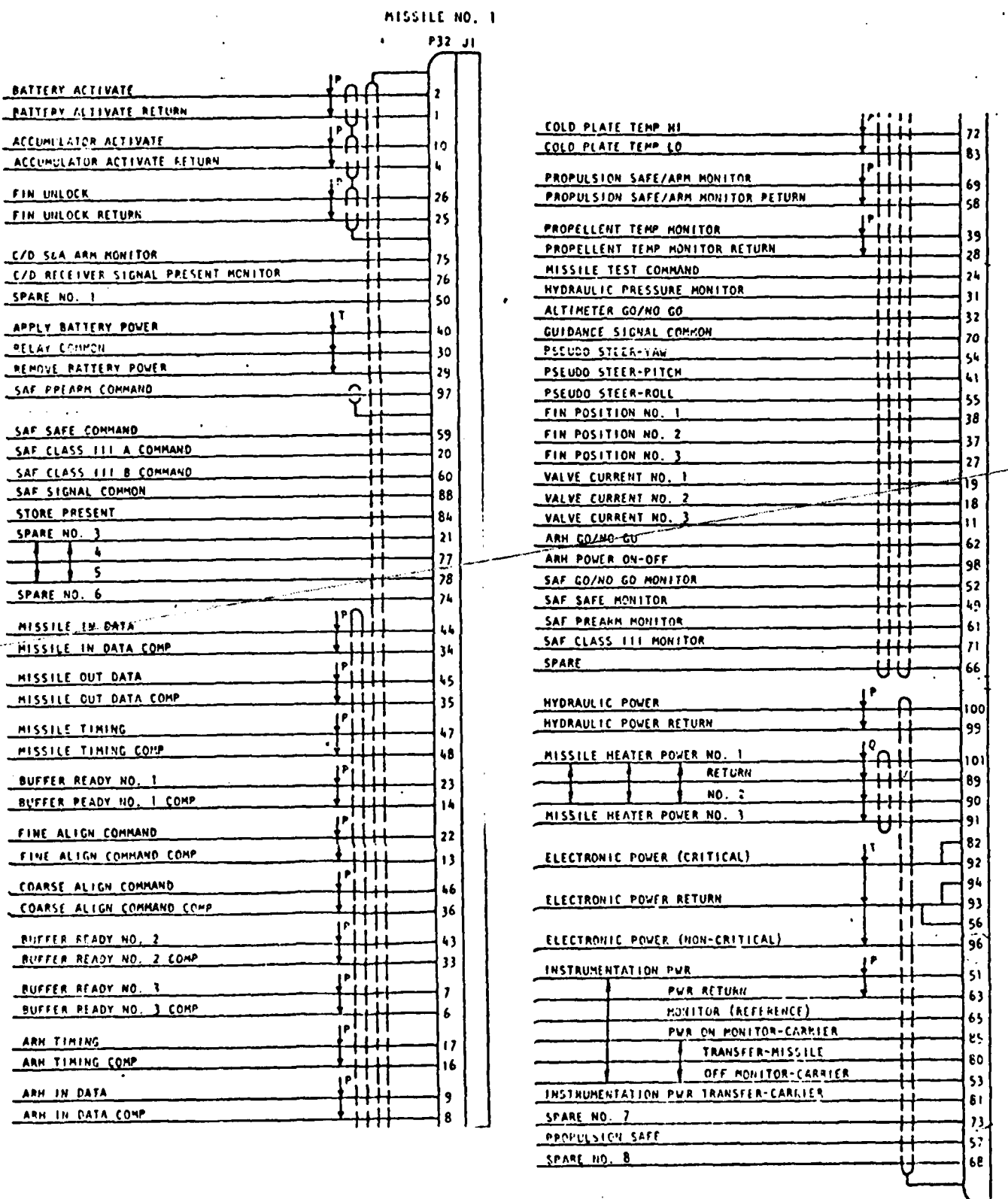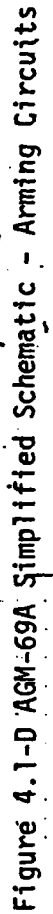
## 4.1.5.1   Ground Rules & Assumptions

Wire resistances and resistances across switches and relays were selected
from parts specifications.  Zero ohms resistance was assumed for cable con-
nections and splices.  Circuit breaker trip-times were determined from
Figure 4.1-E, B-52 Gravity Bomb Circuit Breaker Trip Time V⁻ Current Profile,
and Figures 4.1-F, -G and -H, AGM-69A Circuit Breaker Trip Time Vs Current
Profile.  These curves were obtained from parts specifications.  When appli-
cable, standard temperature was used in determining characteristics.
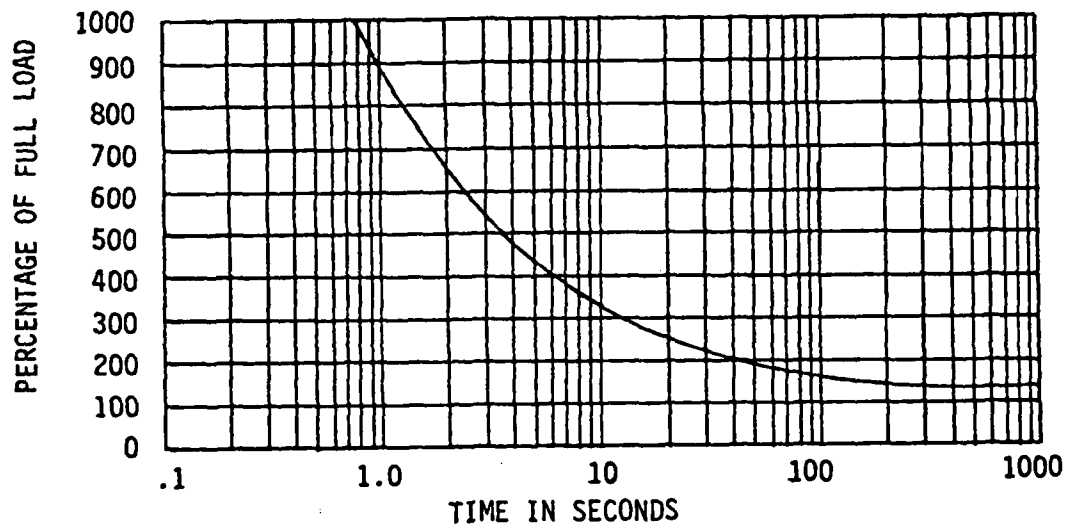
CB TRIP TIME VS CURRENT PROFILE

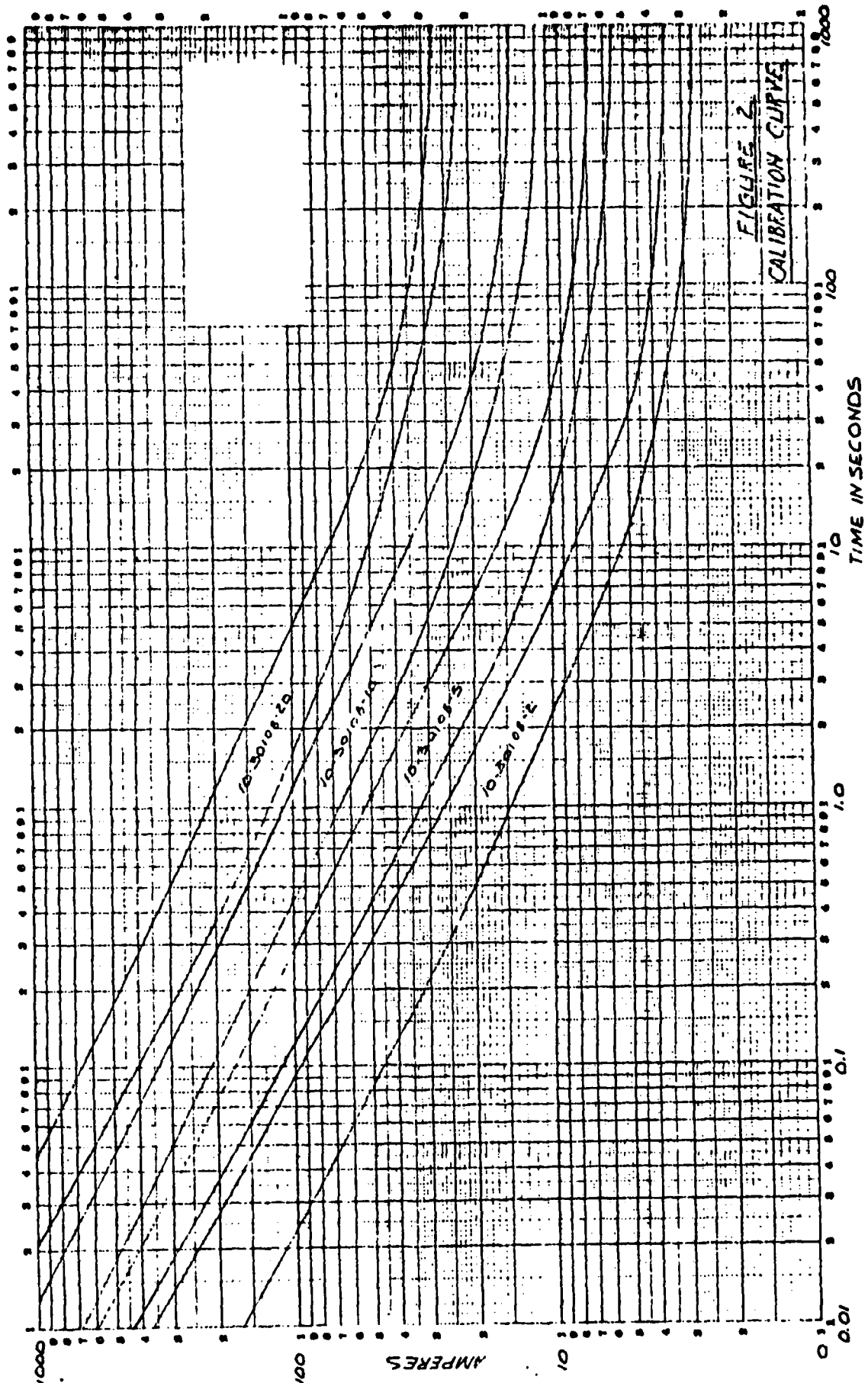Figure 4.1-E Gravity Bomb Circuit Breaker
Trip Time Vs Maximum Current

Fig. 4.1-F AGM-69A Circuit Breaker
Trip Time Vs Current -
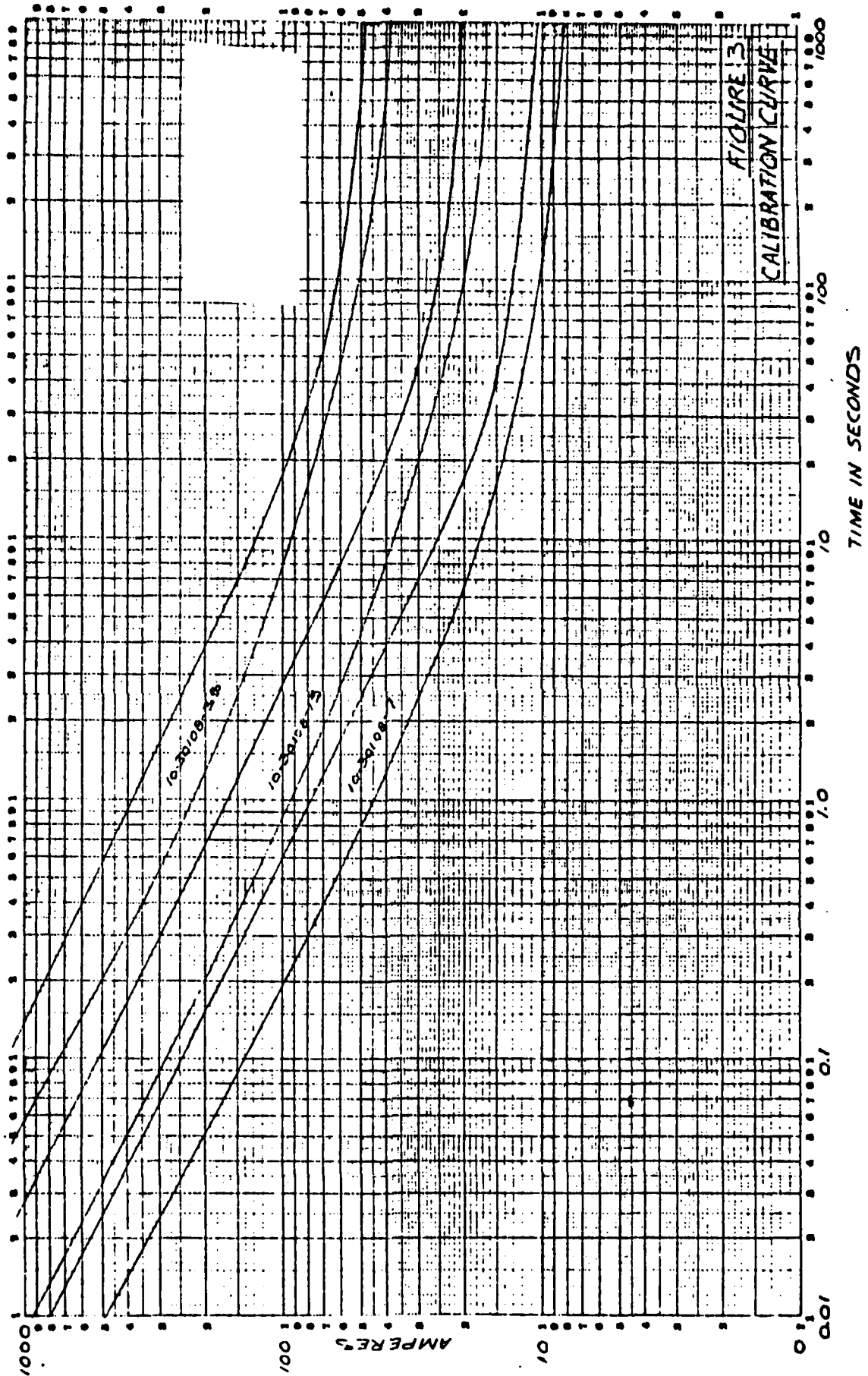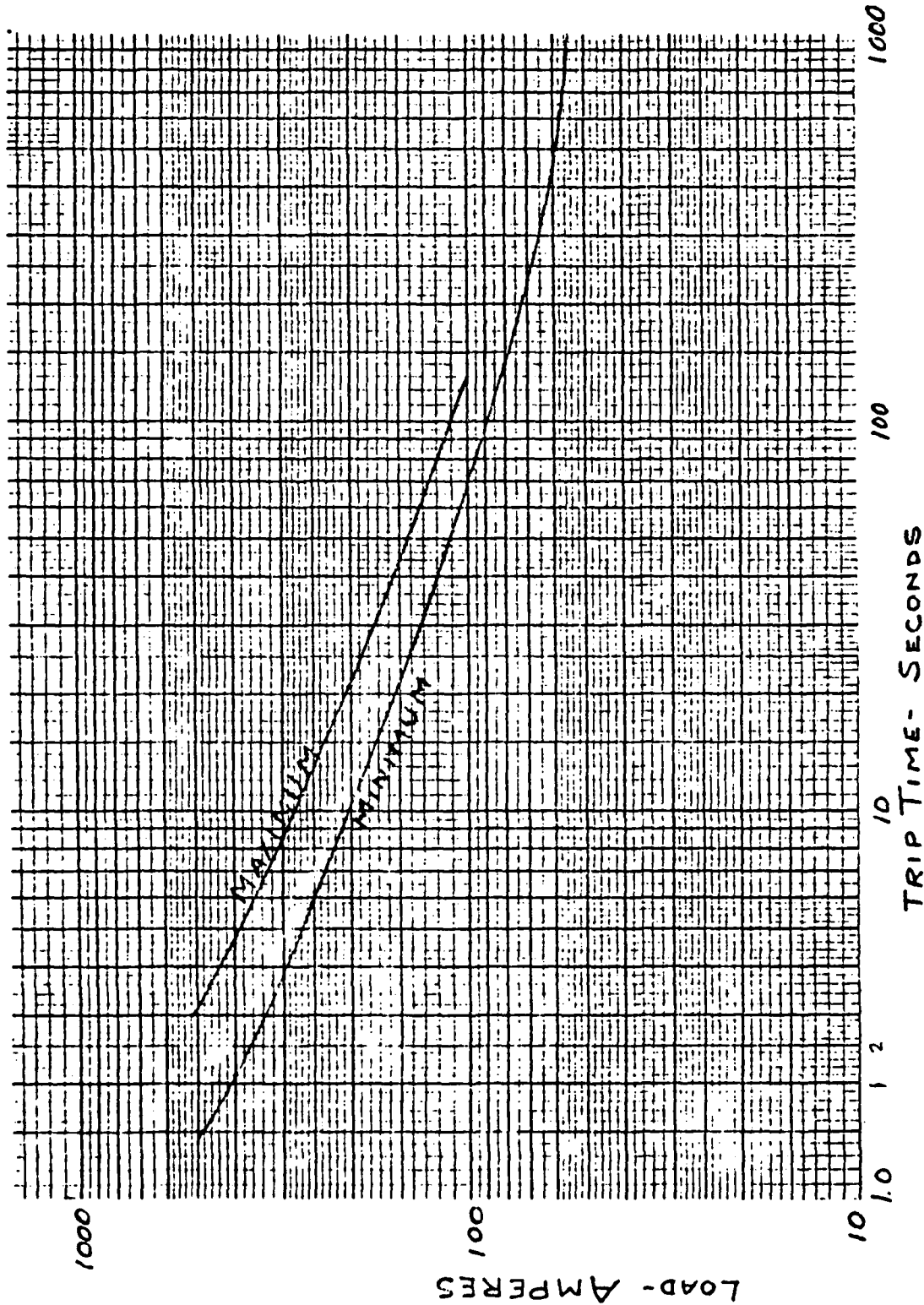2, 5, 10 & 20 A Breakers

Fig. 4.1-G AGM-69A Circuit Breaker
Trip Time Vs Current –
7, 15, & 35 A Breakers

CALIBRATION CURVE - 501     Fig. 4.1-H   AGM-69A Circuit Breaker
Trip Time Vs Current -
60 A Breaker

## 4.1.6    CIRCUIT ANALYSIS PACKAGES

Normal and fault analyses of each network tree are documented in individual packages.  The following analysis packages cover all of the interface circuits to weapons carried in the forward bomb bay on the multiple carriage clip-in assembly:

| | | |
|---|---|---|
| 4.1.6.1 | Pin d | AMAC FWD SYS SECT III & IFC RELAY (Network Tree 0200) |
| 4.1.6.2 | Pin T | POWER FROM TR 4 (Network Tree 80) |
| 4.1.6.3 | Pins T, W & Y | POWER FROM TR 8 (Network Tree 83) |
| 4.1.6.4 | Pins C, f, Z & a | INFLIGHT CONTROL TESTER, DCU-9A (Network Tree 0198) |
| 4.1.6.5 | Pin h | FWD BOMB BAY SAFING (Network Tree 201, 248) |
| 4.1.6.6 | Pins c, J, H & F | INFLIGHT CONTROL TESTER, DCU-9A (Network Tree 0199) |
| 4.1.6.7 | Pins G. L, R, E,D,B,A & P | DCU-9A, INFLIGHT TEST (Network Tree 43B) |
| 4.1.6.8 | Pin X | UNUSED CIRCUITRY (Network Tree 202) |

## NOTE

Power Profiles - In all cases, short circuit current, caused by faults was found to be constant because of the absence of inductors and capacitors in the circuits investigated.  Voltage source impedance was assumed to be zero ohms.  A typical fault current Vs time profile is shown here:
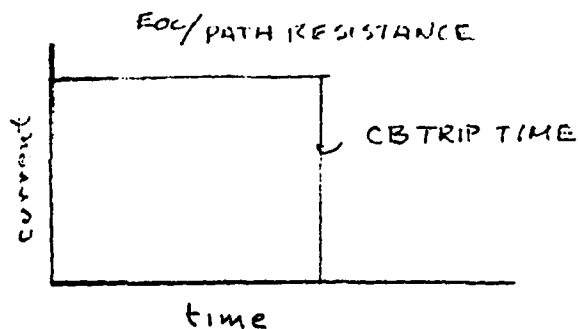


FAULT CURRENT PROFILE

## CLIP-IN ASSEMBLY PIN d
## CIRCUIT ANALYSIS PACKAGE

4.1.6.1   Circuit Analysis Package, Weapon Interface Pin d of Connectors
J11, J12, J13 and J14 on the A114 Clip-In Assembly and Cable In
Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (Change 4) - copy
attached below.  Maximum current available to pin d in a normal environment
is 0 amps.  Worst case current at 24VDC in an abnormal (faulted) environment
would be 152 amps assuming the pin d wires grounded at the weapon and shorted
to power at J932 (AMAC).



Figure 5-2.  Control and Monitor Schematic
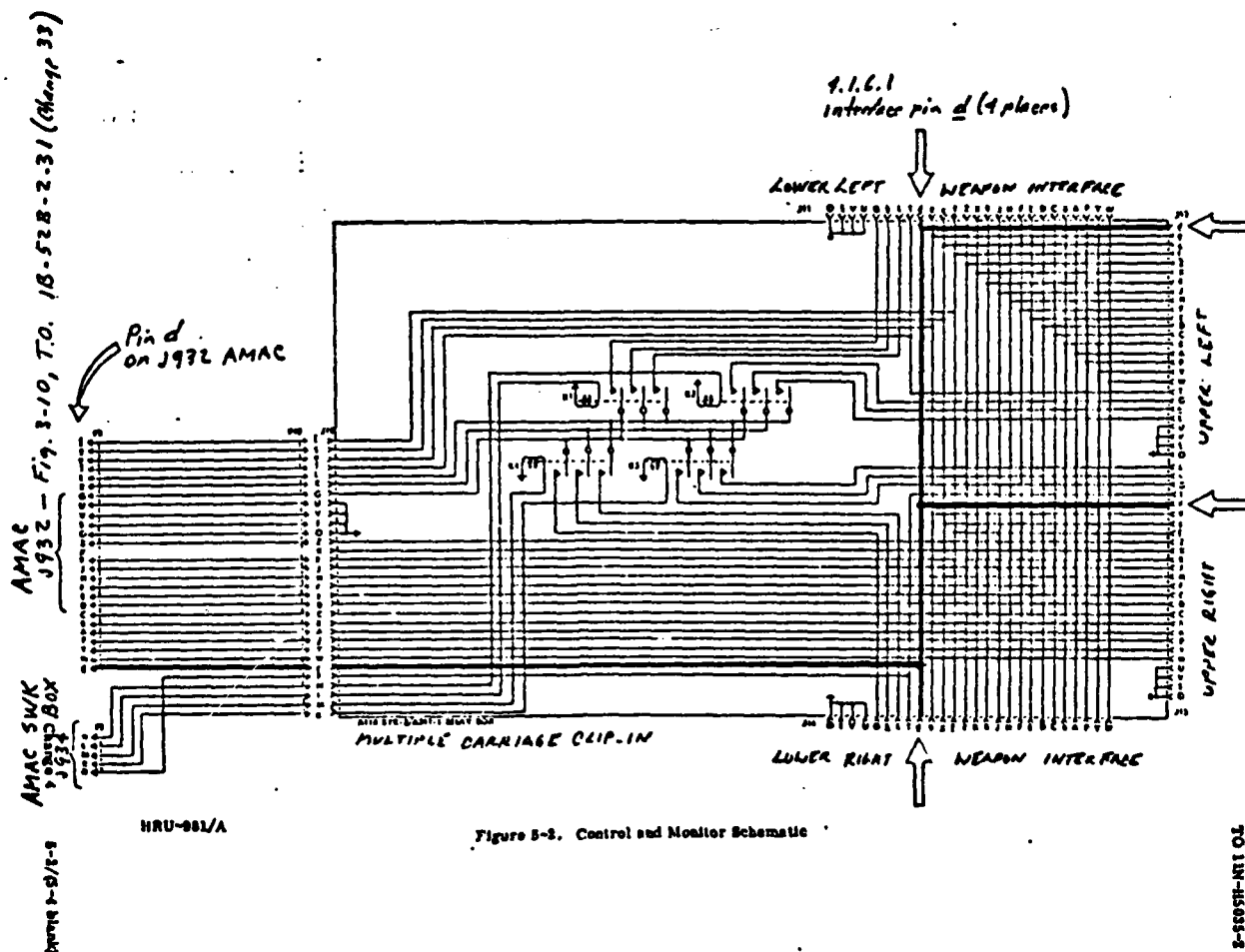
4.1.6.1 (Continued)

a. <u>Normal Power and Load Analysis</u>

From examination of Figure 4.1-1, Network Tree 0200, normal power
environment is without voltage sources.
Open circuit voltage = <u>0</u>V; Short circuit current = <u>0</u>A.

b. <u>Fault Analysis</u>

The following postulated faults were analyzed using Network Tree 0200
and Figure 4.1-2, Cable Drawing:

① <u>Clip-In Assembly or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566 during
Radar Navigator testing using DCU-9/A and the SWK Box.

② <u>Connector J932/P3 or Cable 31-3516-27 Damaged (Worst Case)</u>
Wires to subject pins shorted to 24VDC from CB1565 during testing.
See Figure 4.1-3 for source of voltage.

③ <u>Cable 31-3516-1 Damaged</u>

No voltages present. Cable runs between CSS interconnect box
and weapons interface. The interconnect box opens all circuits.

④ <u>Interconnect Box or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1566 during testing.
See Figure 4.1-4 for source of voltage.

4.1.6.1   (Continued)

c.   Worst Case Path and Calculations

REFERENCE PATH ② in paragraph b.



24 VDC THROUGH .137 Ω FROM CB 1565
REF. FIG 4.1-3 ▷2  (15A)

31-3516-27

AMAC $\frac{J932}{P3}$

.021 Ω / PATH

J11  J12  J13  J14  d

Total resistance of path = .187 Ω

$V_{OC}$ = 24VDC

$I_{SC} = \frac{24}{.158} = \underline{152}$ amps

Time = Less than 0.8 seconds.  Current is greater than 1000%
       circuit breaker rating.

SNEAK CIRCUITS NETWORK TREE | REV

Postulated Faults

Programmer symbol for d.

③ ② NJ-D

A6832
SK3/S COG

AMAC FWD SYS SECT. III
SK3 →④
K399/NOX1

IFC RELAY K399

Ref
S0080
NS0083
K399 GND

① A114 J14/-D
① A114 J12/-D
① A114 J13/-D
① A114 J11/-D

LR UL UR LL

BOMB INTERFACE IN FWD BOMBBAY
PREARMING POWER SUPPLIED
THROUGH BOMB

LR = LOWER RIGHT BOMB
UR = UPPER RIGHT BOMB
LL = LOWER LEFT BOMB
UL = UPPER LEFT BOMB

O FAULTS - SEE FAULT ANALYSIS,
¶ 9.1.6.1b

MONITOR & CONTROL SYS          DRAWING, TO11N-H5035-2SL

| PROJECT B52G | TITLE AMAC FWD SYS SECT III & IFC RELAY | |
|---|---|---|
| QC jlc | DATE 9-2-75 | ANALYST P.V. | DATE 8-19-75 | NODAL SET 0200 |

BOEING AEROSPACE COMPANY - HOUSTON, TEXAS

Figure 4.1.1 Network Tree No. 0200

④ CSS INTERCONNECT BOX
A6832

SEE FIG 4.1-4 → | P16654

③ ⊂⊃ 31-3516-1

• SP

② ⊂⊃ 31-3516-27

J432          J934
P3            P2

① ⊙→⊂⊃

J10
CLIP-IN ASSY
A114

J11   J12   J13   J14   d

⊂⊃ CABLE GROUP
○ FAULT
   SEE FAULT
   ANALYSIS
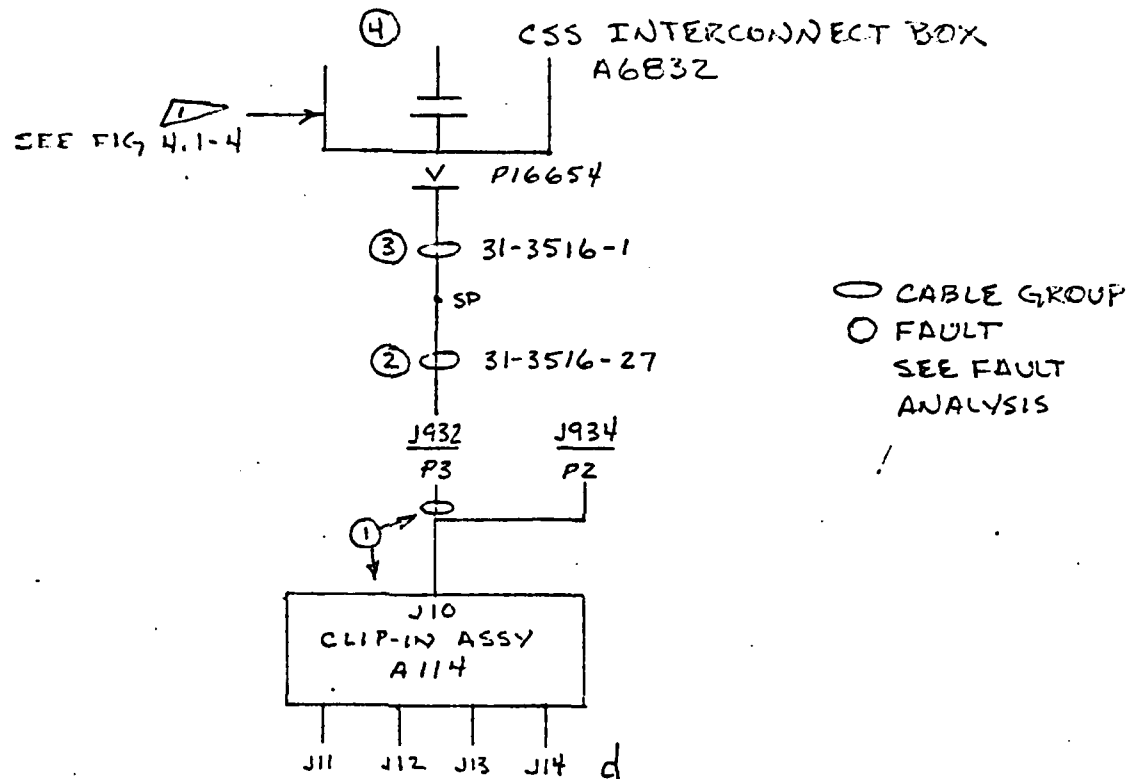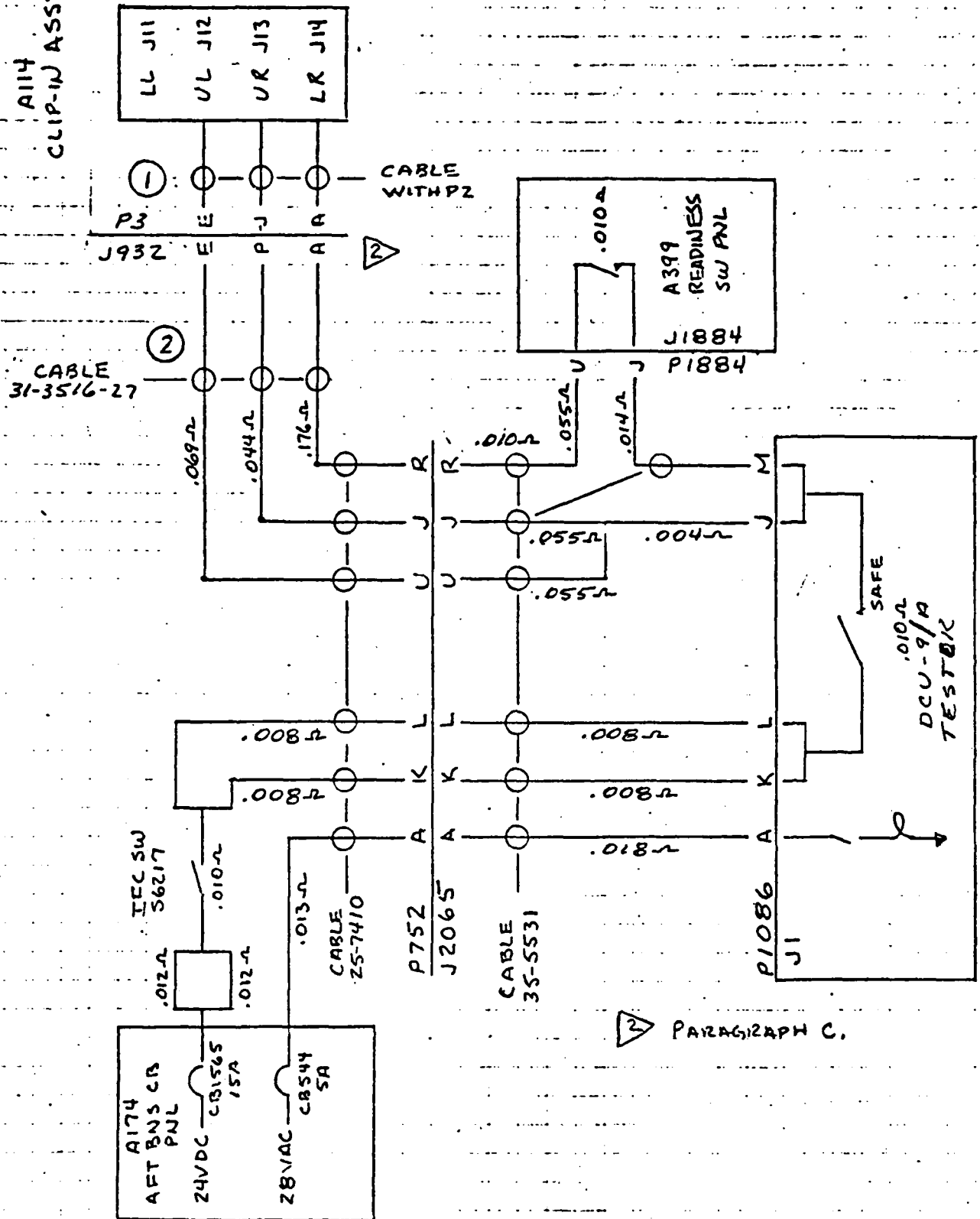
FIGURE 4.1-2

CABLE DRAWING

Figure 4.1-3  Power Paths Through DCU-9/A Tester
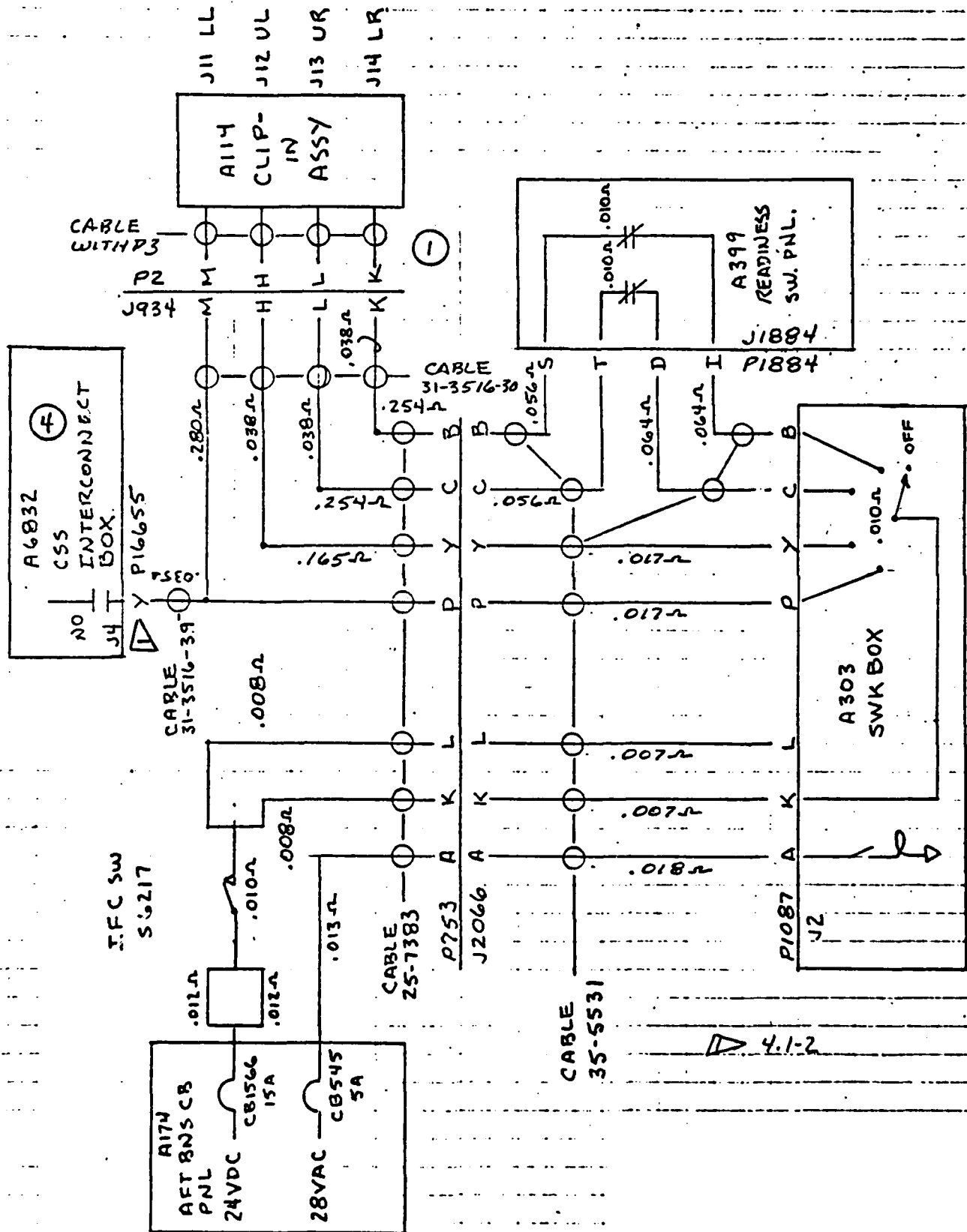
Figure 4.1-4 Power Paths Through SWK Box

CLIP-IN ASSEMBLY UPPER
AND LOWER RIGHT WEAPON
INTERFACE PINS T
CIRCUIT ANALYSIS PACKAGE

4.1.6.2   Circuit Analysis Package, Weapon Interface Pins T of Connectors
         J13 and J14 on A114 Clip-In Assembly and Cable in Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (Change 4) - copy
attached below.  Maximum current available to pin T in a normal environment
is 0 amps.  Worst case current at 28VDC in an abnormal (faulted) environment
would be 1000 amps, assuming the pins grounded at the weapon and shorted to
power at IFC relay.



Figure 5-2.  Control and Monitor Schematic
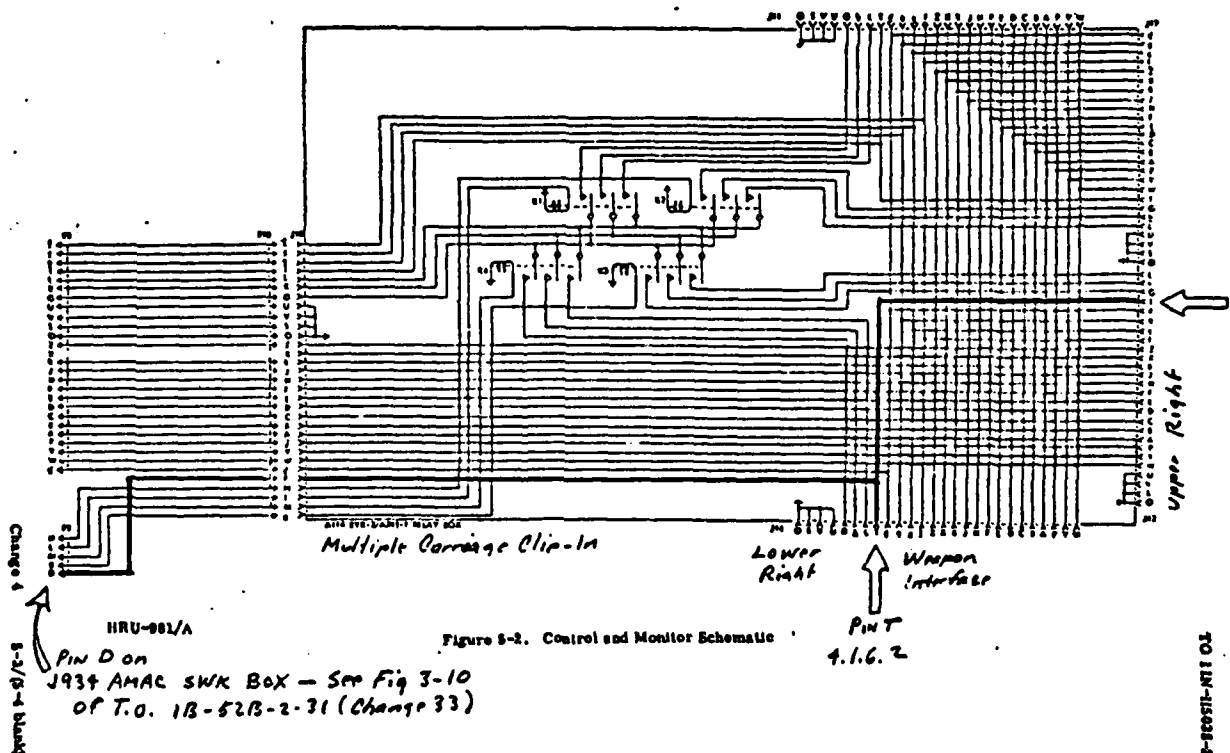
4.1.6.2   (Continued)

a.   Normal Power and Load Analysis

From examination of Figure 4.1-5, Network Tree 80, normal power
environment is with K399 open.

Open circuit voltage = $\underline{0}$V; Short circuit current = $\underline{0}$A.

b.   Fault Analysis

The following postulated faults were analyzed using Network Tree 80
and Figure 4.1-6, Cable Drawing.

①   Clip-In Assembly or Connector Damaged

Wires to subject pins shorted to 24VDC from CB1565 or CB1566
during Radar Navigator Testing with the DCU-9/A and SWK Box.
See Figures 4.1-7 and 4.1-8 for voltage source.

②   Cable 31-3516-30 or Connector J934/P2

Wires to subject pins shorted to 24VDC from CB1566 during testing.
See Figure 4.1-8 for voltage source.

③   IFC Relay K399 Damaged (Worst Case)

Pin L3 to T3 28VDC from CB549
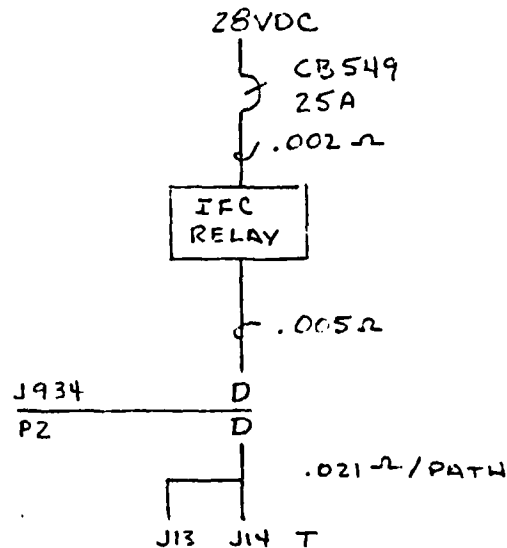    L1 to T3 28VDC from CB548
    L2 to T3 28VDC from CB550
    See Figure 4.1.6 for voltage sources

4.1.6.2 (Continued)

c. <u>Worst Case Path</u>

Reference path ③ IFC Relay K399 Damaged (from paragraph b).



Total resistance of path .028 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.028} = \underline{1000}$ Amps

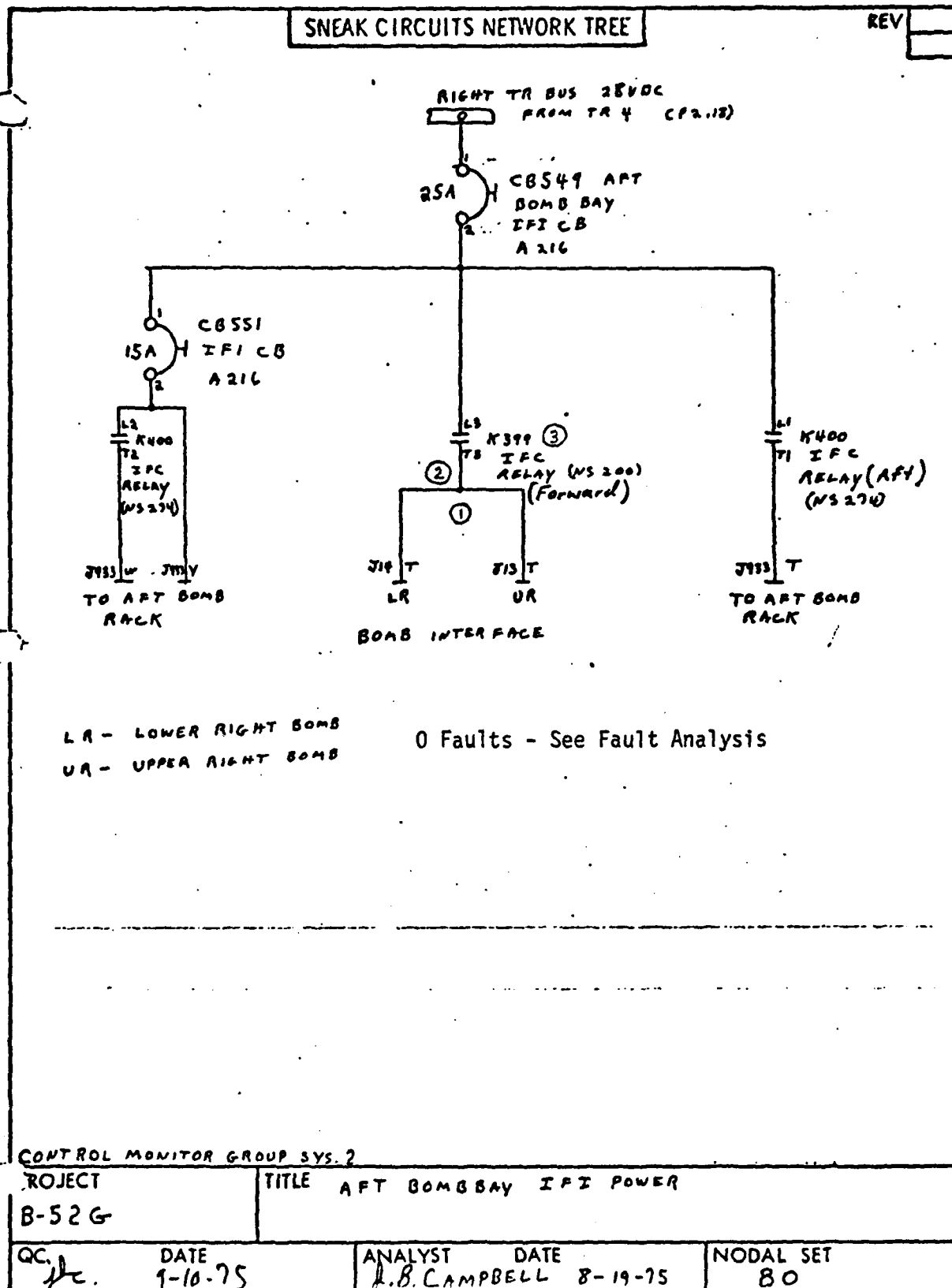Time = Less then 0.8 seconds for circuit breaker to open.

SNEAK CIRCUITS NETWORK TREE
REV

RIGHT TR BUS 28VDC
FROM TR 4   (P2.18)

25A    CB549 AFT
       BOMB BAY
       IFI CB
       A 216

15A    CB551
       IFI CB
       A 216

L2 K400
T2 IFC
   RELAY
   (WS 274)

L3 K399 ③
T3 IFC
   RELAY (WS 200)
   (Forward)

L1 K400
T1 IFC
   RELAY (AFT)
   (WS 274)

J933 W   J933 V
TO AFT BOMB
RACK

②

①

J14 T      J13 T
LR         UR

J933 T
TO AFT BOMB
RACK

BOMB INTERFACE

LR - LOWER RIGHT BOMB
UR - UPPER RIGHT BOMB

0 Faults – See Fault Analysis

CONTROL MONITOR GROUP SYS. 2

| PROJECT | TITLE   AFT BOMB BAY  IFI POWER | | |
|---------|---------|---|---|
| B-52G | | | |

| QC. | DATE 9-10-75 | ANALYST   DATE | NODAL SET |
|-----|-----|-----|-----|
| | | L.B. CAMPBELL   8-19-75 | 80 |

HOU-705          *BOEING* AEROSPACE COMPANY - HOUSTON, TEXAS

Figure 4.1-5  Network Tree No. 80

28VDC

CB549
25A

.002 Ω

CB548
25A      .036 Ω

28VDC

5A      .090 Ω
CB550

③  IFC RELAY
NO  K399

A217
LH FWD DC
LOAD BOX

31-3516-30
②

J932

P2

P3/J932

①

J10
CLIP-IN ASSY
A114

J13    J14

⬭ CABLE GROUP

◯ FAULTS

CABLE DRAWING

FIGURE 4.1-6

Figure 4.1-7 Power Paths Through DCU-9/A Tester
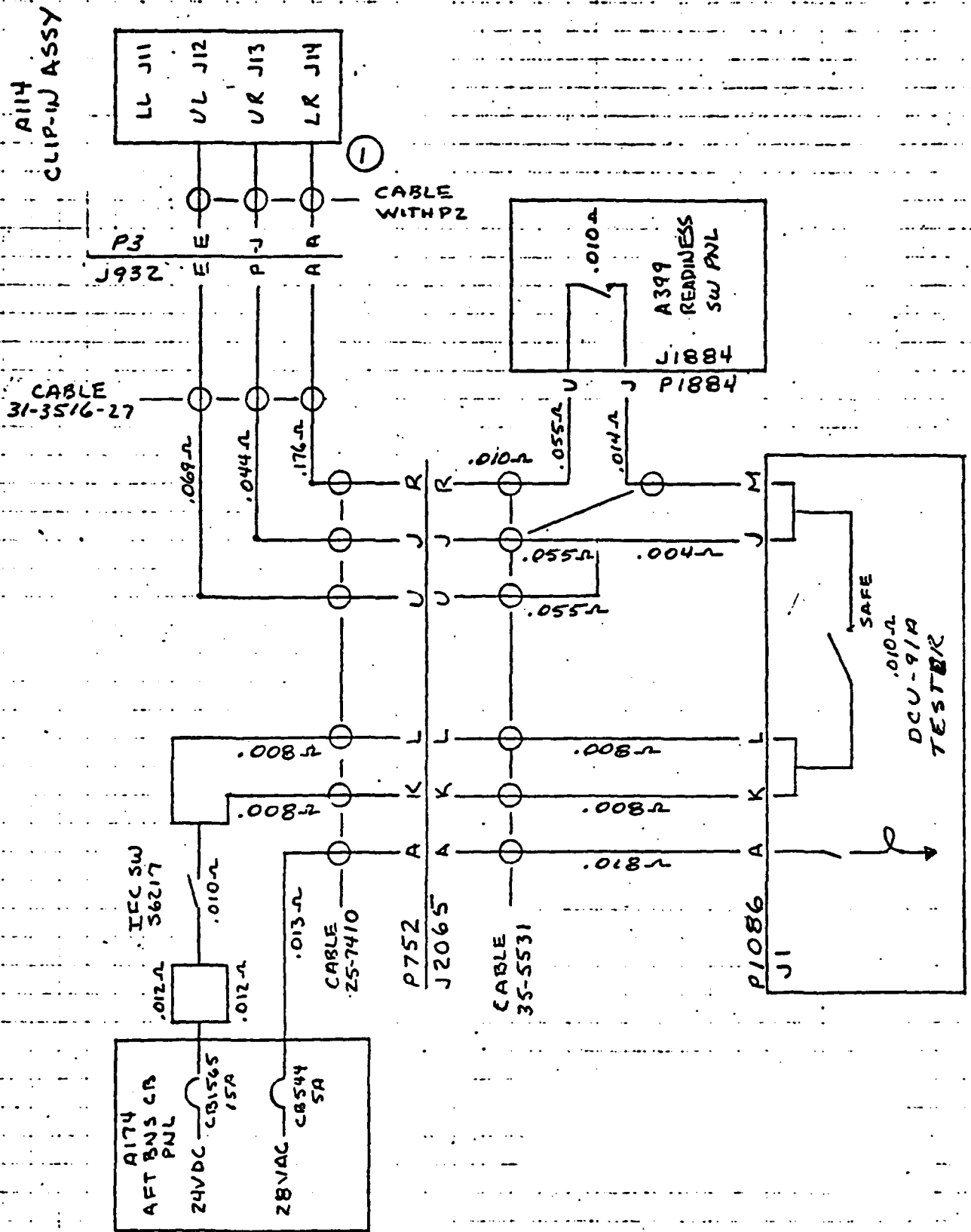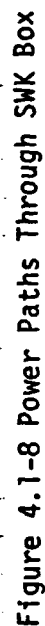
Figure 4.1-8 Power Paths Through SWK Box

CLIP-IN ASSEMBLY PINS T, W & Y

CIRCUIT ANALYSIS PACKAGE

4.1.6.3   Circuit Analysis Package, Weapon Interface Pins W & Y of
Connectors J11, J12, J13 and J14; and Pin T of Connectors
J11 and J12 on A114 Clip-In Assembly and Cable in Forward
Bomb Bay

These interfaces are shown in Figure 5-2, T. O. 11N-H5035-2 (Change 4) -
Copy attached below.  Maximum current available to pins T, W and Y in a
normal environment is 0 amps.  Worst case current at 28VDC is an abnormal
environment (faulted) would be 1170 amps for pins T and 800 amps for
pins W and Y assuming the pins are grounded at the weapon and shorted to
power through IFC relay.



Figure 5-2. Control and Monitor Schematic
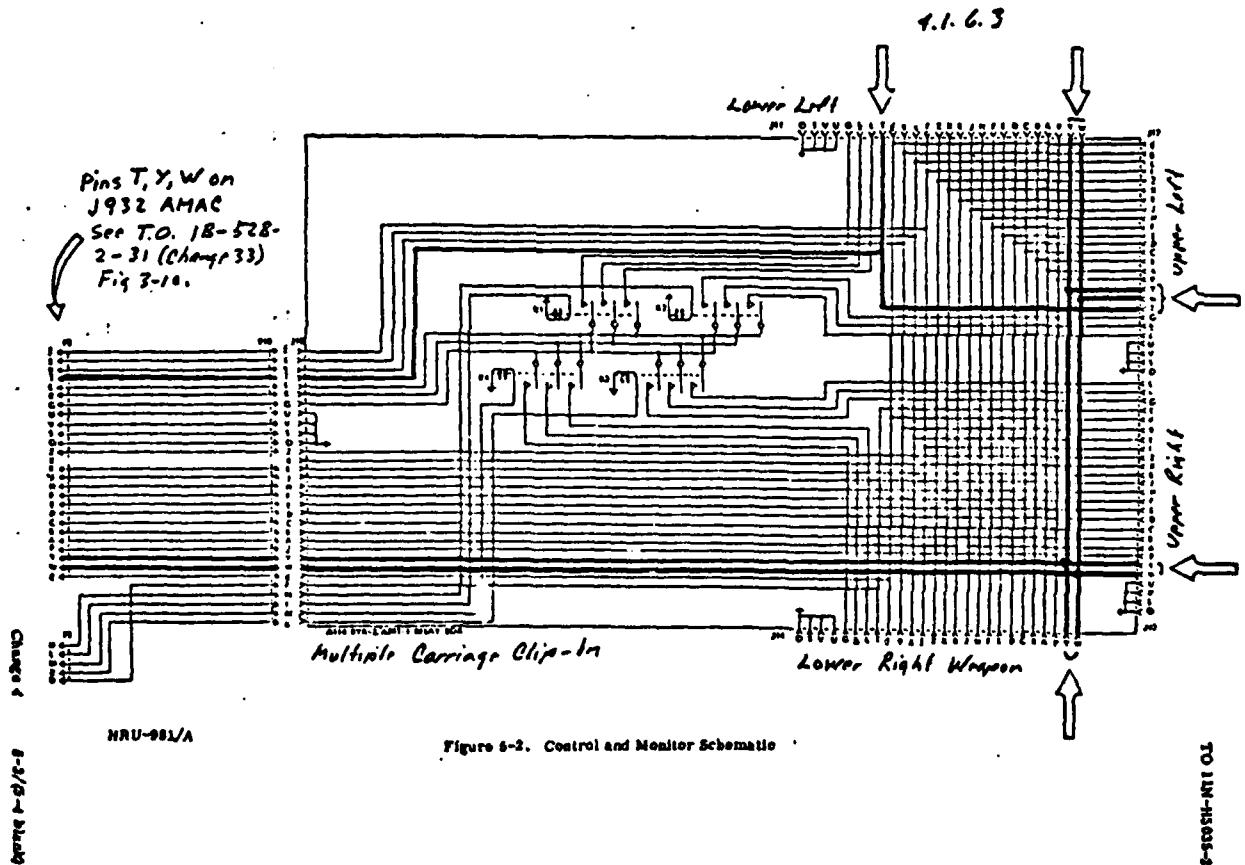
4.1.6.3   (Continued)

a.  Normal Power and Load Analysis

From examination of Figure 4.1-9, Network Tree No. 83, normal power
environment or all pins:  Open circuit voltage = $\underline{0}$V; short circuit
current = $\underline{0}$A, because K399 is normally open.

b.  Fault Analysis

The following postulated faults were analyzed using Network Tree No. 83
and Figure 4.1-10, Cable Drawing:

①     Clip-In Assembly or Connector Damaged
Wires to subject pins shorted to 24VDC from CB1565 or CB1566
during Radar Navigator  testing.  See Figures 4.1-11 and 4.1-12
for source of voltage.

②     Cable 31-3516-27 or Connector J932/P3 Damaged
Wires to subject pins shorted to 24VDC from CB1565 during
Radar Navigator testing.  See Figure 4.1-12 for source of
voltage.

③     IFC Relay K399 Damaged (Worst Case)
Reference Figure 4.1-10.
L2 to T2 28VDC from CB550
L1 to T1 28VDC from CB548
L1 to T2 28VDC from CB548
L2 to T1 28VDC from CB550
L3 to T1 or T2 28VDC from CB549
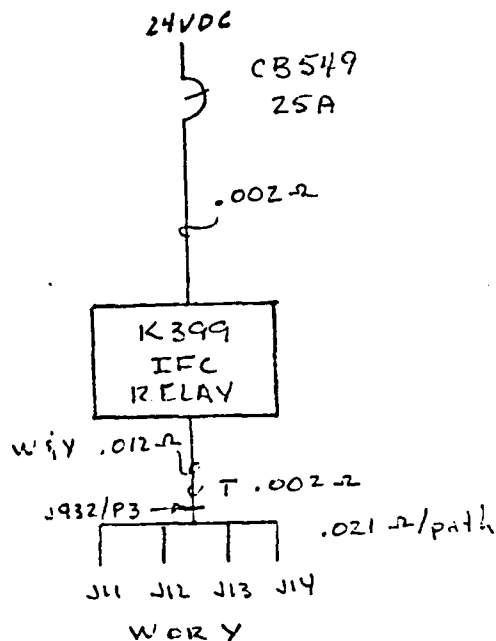
4.1.6.3   (Continued)

c.   <u>Worst Case Path</u>

Reference Path ③  IFC Relay K399 Damaged.

J11, J12, J13 and J14 Y or W

J11 and J12T



Pin  T

Total resistance = .024 $\Omega$

$V_{OC}$ = 28VDC

$I_{SC} = \frac{28}{.024} = \underline{1170}$ amps

Pins W & Y

Total resistance = .035 $\Omega$

$V_{OC}$ = 28VDC

$I_{SC} = \frac{28}{.035} = \underline{800}$ amps

Time - less then 0.8 seconds for
        circuit breaker to open.

SNEAK CIRCUITS NETWORK TREE

REV

PWR FROM TR NO.8 LEFT SIDE (PIC) (28 VDC)

CB548 (A217)
25A FWD BOMBAY
IFI PWR

CB550
15A IFI CONT
(A217)

K399 (NS200)
IFC RELAY

K399
IFC RELAY
(NS 200)

K400
T3 (NS274)
IFC
RELAY

J935/D
TO AFT
BOMB RACK

A114

A114

A114

J11 Y   J12 Y   J13 Y   J14 Y        J11 W   J12 W   J13 W   J14 W        J11 T        J12 T
LL      UL      UR      LR           LL      UL      UR      LR           LL           UL

BOMB   INTERFACE  IN  FWD  BOMBBAY

O  Faults

LL - LOWER LEFT BOMB
UL - UPPER LEFT BOMB
UR - UPPER RIGHT BOMB
LR - LOWER RIGHT BOMB

CONTROL MONITOR GROUP - SYS. 1                    DWG. A8.14

| PROJECT | TITLE | FWD BOMB BAY IFI PWR | |
|---|---|---|---|
| B-52 G | | | |
| QC | DATE 9-11-75 | ANALYST  L.R. Campbell  DATE 8-18-75 | NODAL SET 83 |

HQU-205          BOEING AEROSPACE COMPANY - HOUSTON, TEXAS

Figure 4.1-9   Network Tree No. 83

4-34

28VDC

CB550    CB548    A217  LH  FWD
15A      25A      DC  LOAD  BOX

.090Ω          .036Ω

CB549

K399   IFC  RELAY

25A      .002Ω

③

L2    L1
T2    T1

A216  RH  DC
LOAD  BOX

② ◯ CABLE  31-3516-27

J932    J934
P3      P2

CABLE ◯- -◯   ①

◯  FAULTS

◯  CABLE  GROUP

J10

A114
CLIP-IN  ASSY

J11   J12   J13   J14

CABLE  DRAWING

FIGURE  4.1-10

Figure 4.1-11 Power Paths Through SWK Box

Figure 4-1-12 Power Paths Through DCU-9/A Tester
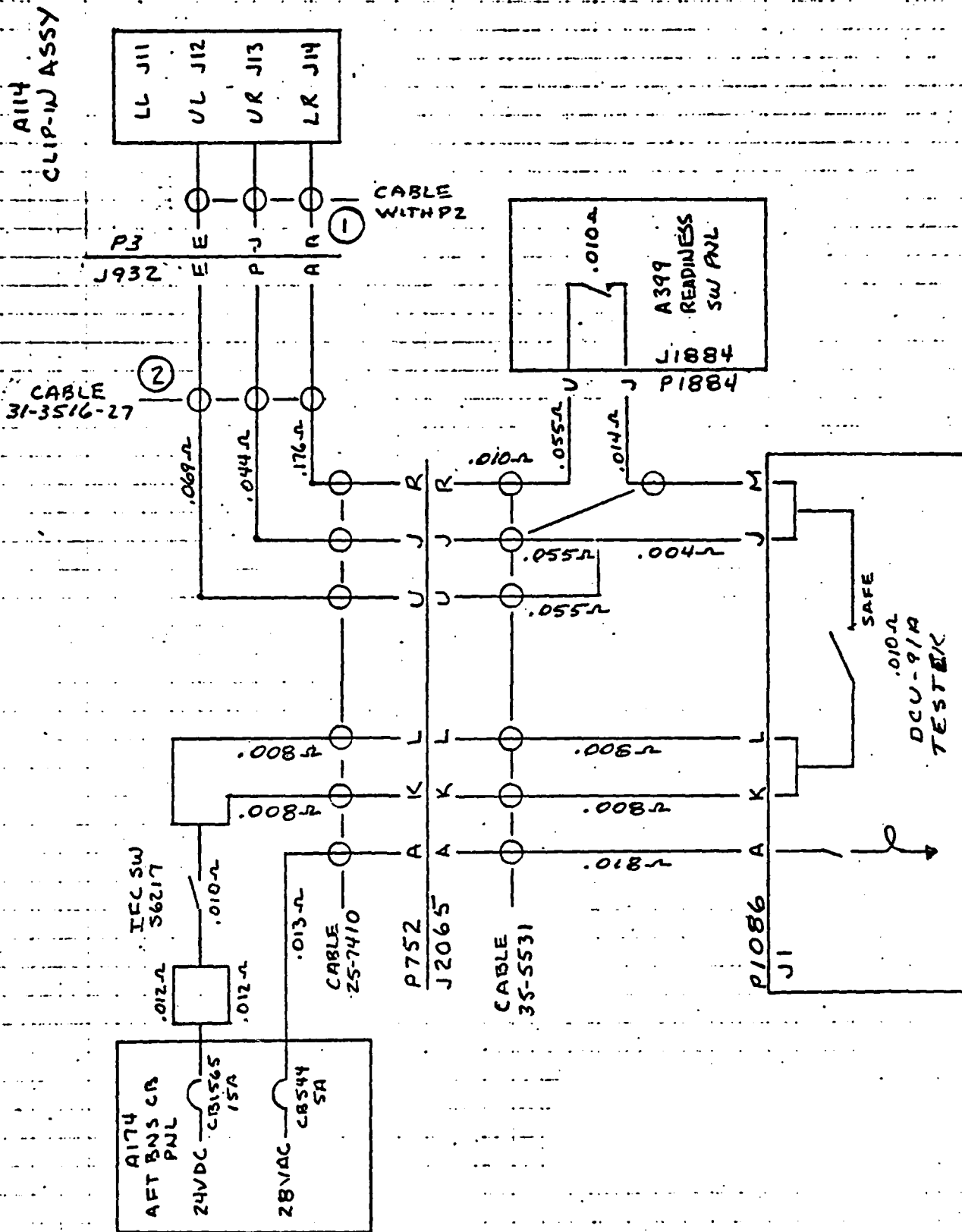
4.1.6.4   (Continued)

a.  <u>Normal Power and Load Analysis</u>

From examination of Figure 4.1-13, Network Tree No. 0198, normal open
circuit voltage = <u>0</u>V; short circuit current ≈ <u>0</u>A.

b.  <u>Fault Analysis</u>

The following postulated faults were analyzed using Network Tree
No. 0198 and Figure 4.1-14, Cable Drawing.

①   <u>Clip-In Assembly or Connector Damaged</u>
Wires to subject pins shorted to 24VDC during testing using
DCU-9/A and the SWK box from CB1565 or CB1566.  See
Figure 4.1-15 and 4.1-16 for power paths.

②   <u>Cable 31-3516-27 or Connectors Damaged</u>
Wires to subject pins shorted to 24VDC during testing from
CB1565.  See Figure 4.1-15 for power paths.

③   <u>Cable 25-7410 or Connectors Damaged</u> (Worst Case)

Wires to subject pins shorted to 24VDC from CB1565 or 28VAC
from CB544.  See Figure 4.1-15 for power paths.

④   <u>Cable 35-5531 or Connectors Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566
on 28VDC from CB544 or CB585.  See Figure 4.1-15 or 4.1-16 for power paths.

⑤   <u>DCU/9A Testor or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or 28VAC
from CB544.  See Figure 4.1-15  for power paths.

CLIP-IN ASSEMBLY PINS

C, f, Z & a

CIRCUIT ANALYSIS PACKAGE

4.1.6.4    Circuit Analysis Package, Weapons Interface Pins C, f, Z, a
of Connectors J11, J12, J13 and J14 on A114 Clip-In Assembly
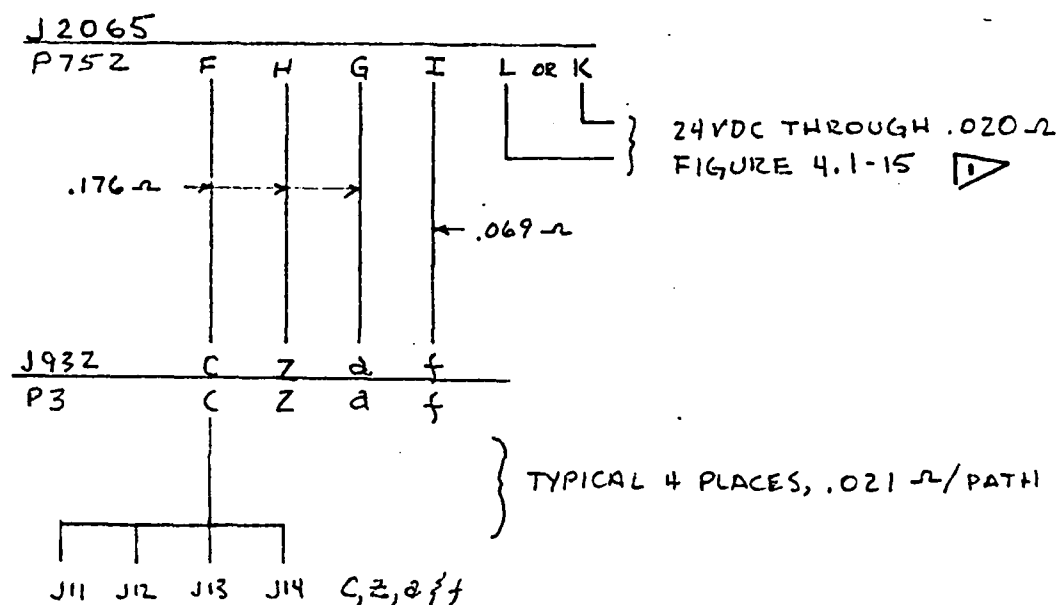and Cable in Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (change 4)
Copy attached below.  Maximum current available to pins C, f, Z and a in
a normal environment is 0 amps.  Worst case current at 24VDC in an ab-
normal (faulted) environment would be 218 amps for pin f and 110 amps
for pin C, Z and a, assuming the pins grounded at the weapon and shorted
to power at J2065/P752 connector.
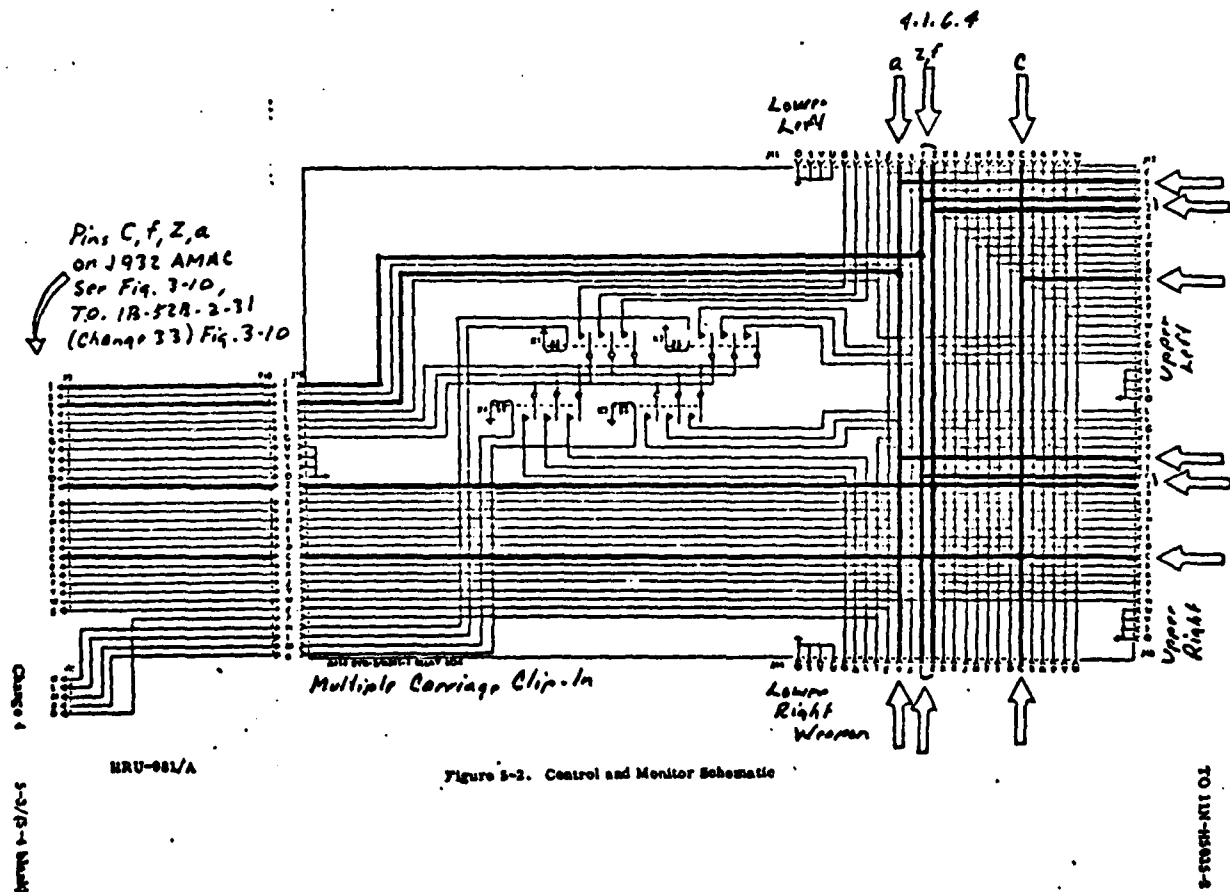


Figure 5-2.  Control and Monitor Schematic

4.1.6.4    (Continued)

c.    Worst Case Path and Calculations

Reference Path ③ Cable 25-7410 or Connectors Damaged.

J2065
P752    F    H    G    I    L or K

.176 Ω →  →  →

24 VDC THROUGH .020 Ω
FIGURE 4.1-15 ▷

← .069 Ω

J932    C    Z    a    f
P3      C    Z    a    f

TYPICAL 4 PLACES, .021 Ω/PATH

J11   J12   J13   J14   C, Z, a & f

Pin f            Total resistance = .110 Ω

$V_{OC} = 24VDC$
$I_{SC} = \dfrac{24}{.110} = \underline{218}$ Amps
Time = less than 0.8 seconds.

Pins C, Z, & a    Total resistance = .217 Ω

$V_{OC} = 24VDC$
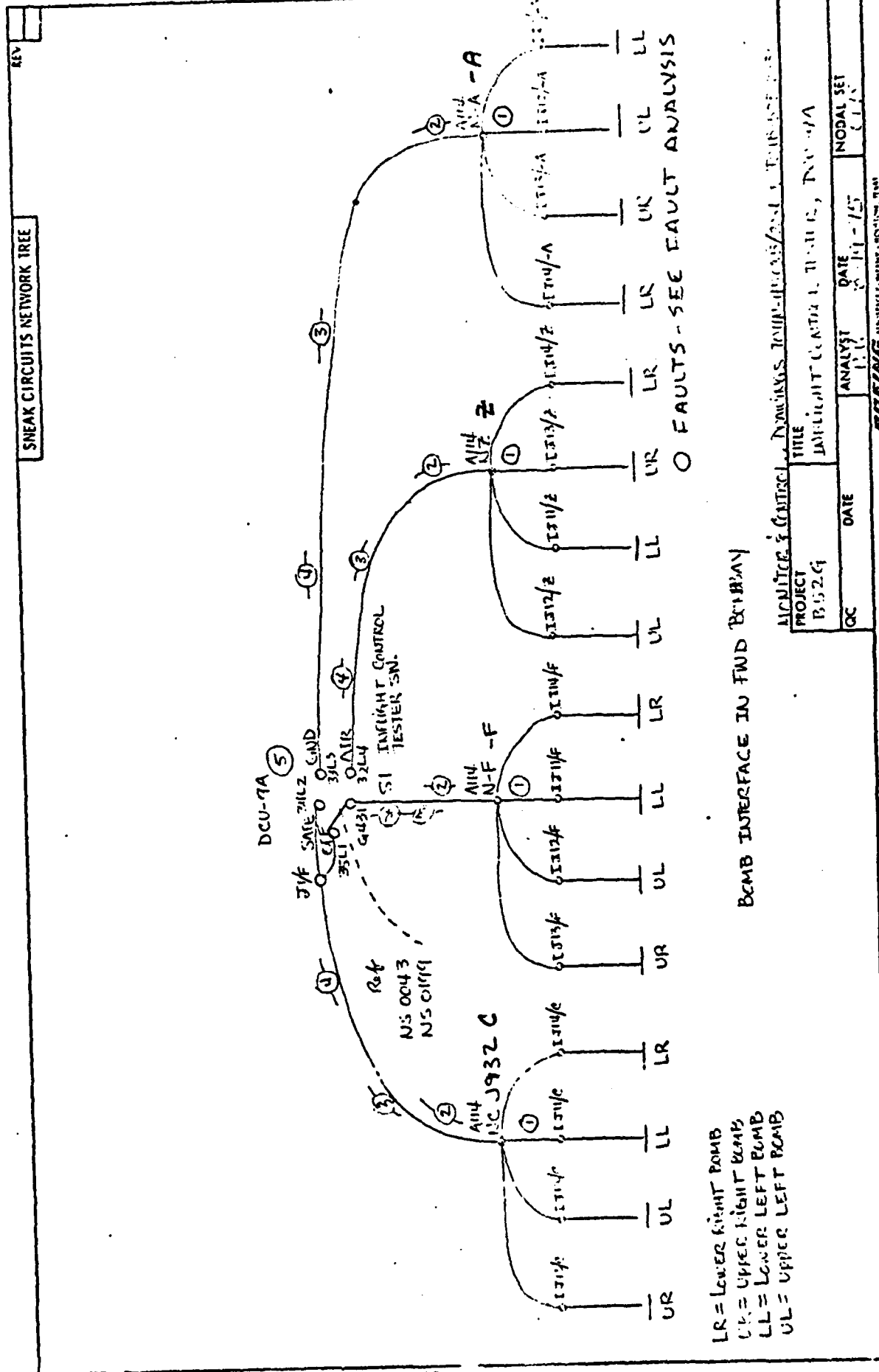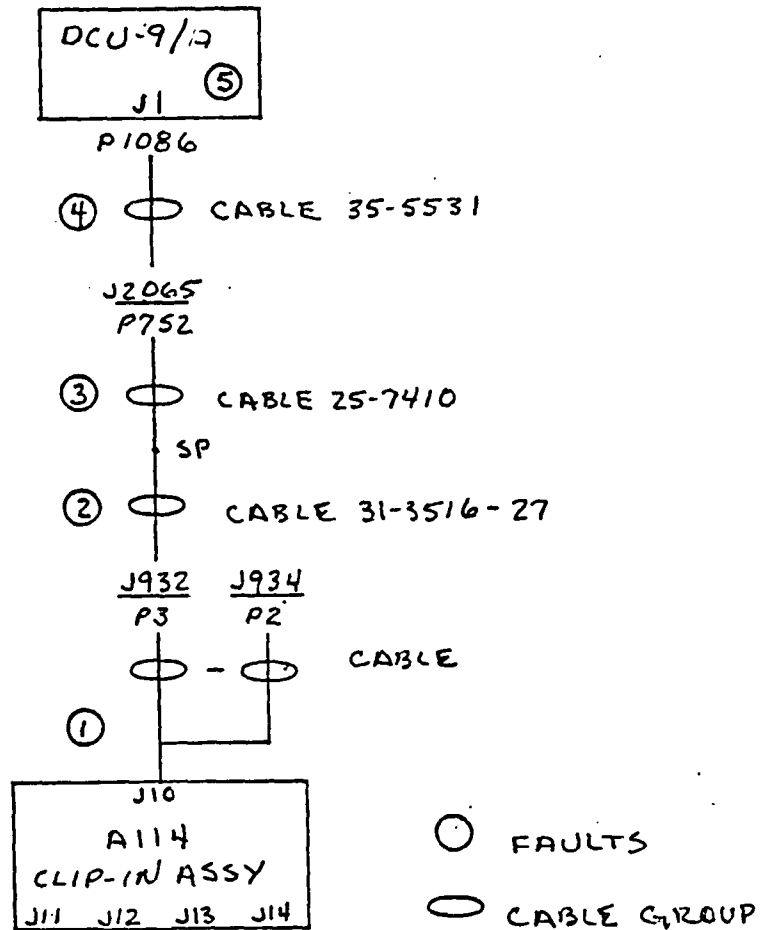$I_{SC} = \dfrac{24}{.217} = \underline{110}$ amps
Time = 1.1 seconds maximum.

4-40

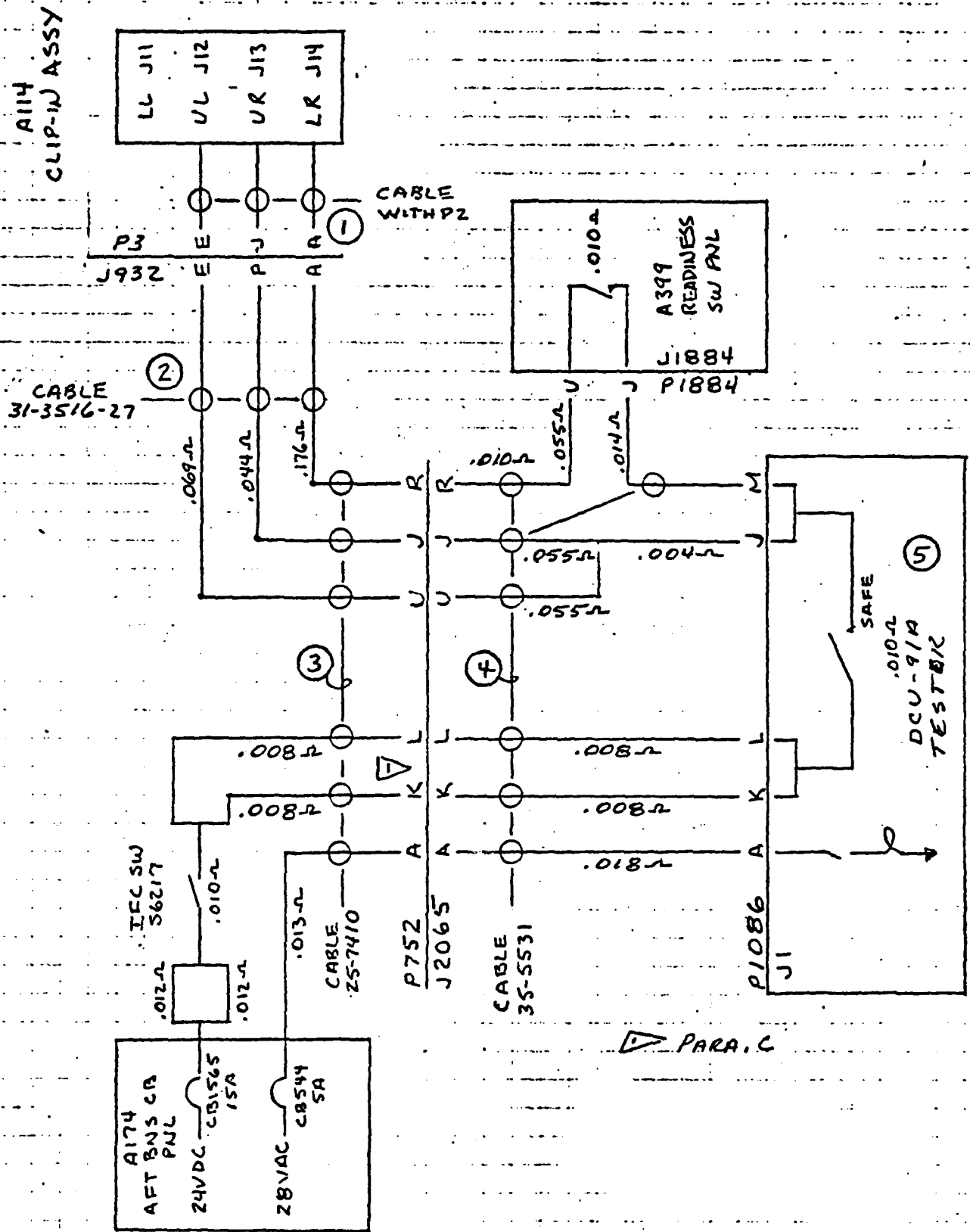Figure 4.1-13 Network Tree No. 0198

CABLE DRAWING

FIGURE 4.1-14

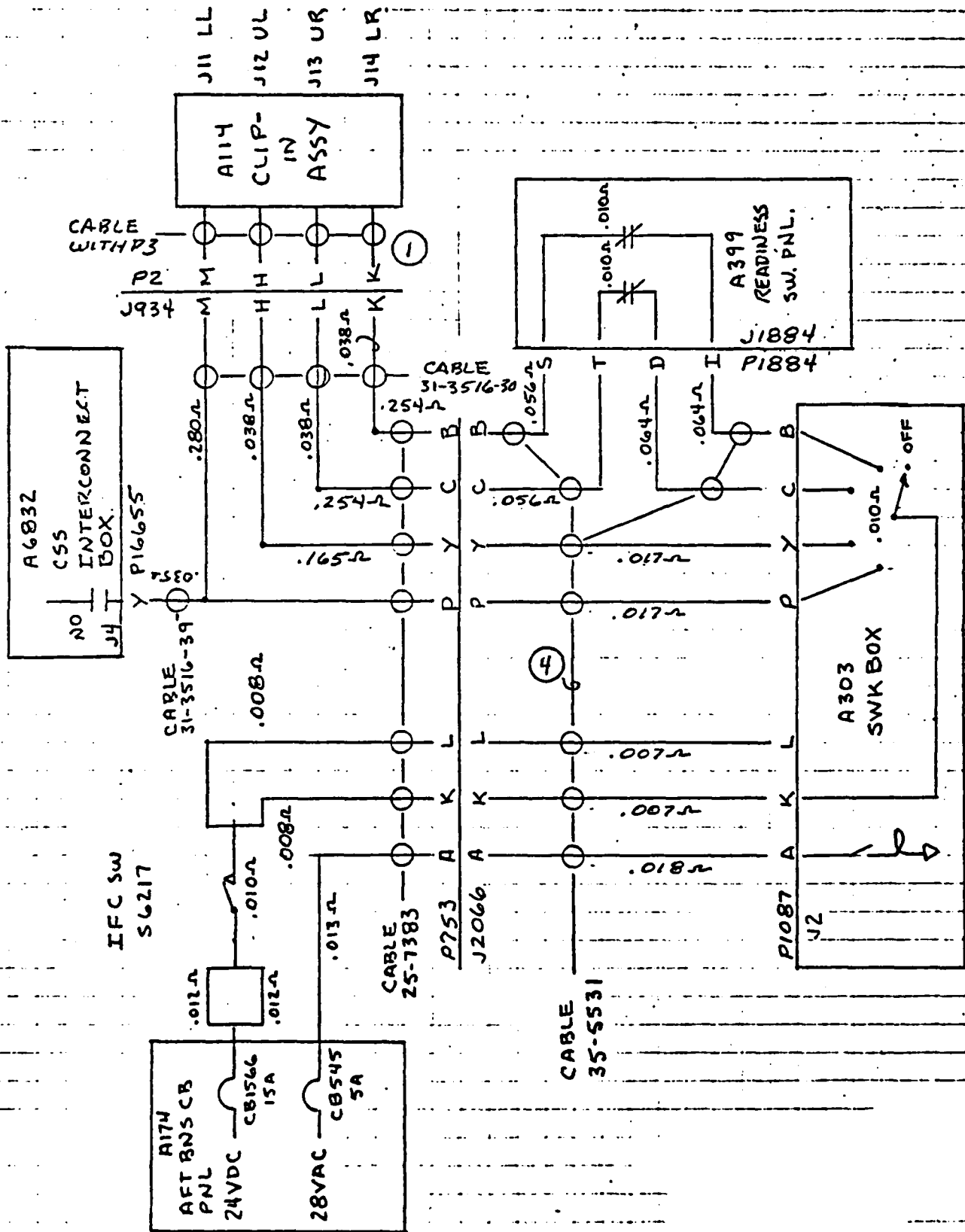Figure 4.1-15, Power Paths Through DCU-9/A Tester

Figure 4.1-16, Power Paths Through DCU-9/A Tester

## CLIP-IN ASSEMBLY PIN h
## CIRCUIT ANALYSIS PACKAGE

4.1.6.5   Circuit Analysis Package, Weapon Interface Pin h of Connectors
J11, J12, J13 and J14 on A114 Clip-In Assembly and Cable in
Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (Change 4) - copy
attached below.  Note that Pin h connects to cable Pin K through relay contacts.
Maximum current available to pin h in a normal environment is 0 amps.  Worst
case current at 24VDC in an abnormal (faulted) environment would be 152 amps
assuming the pin grounded at the weapon and the SWK Box not switched "Off".
With the SWK "off", the relay contacts in A114 would be open.
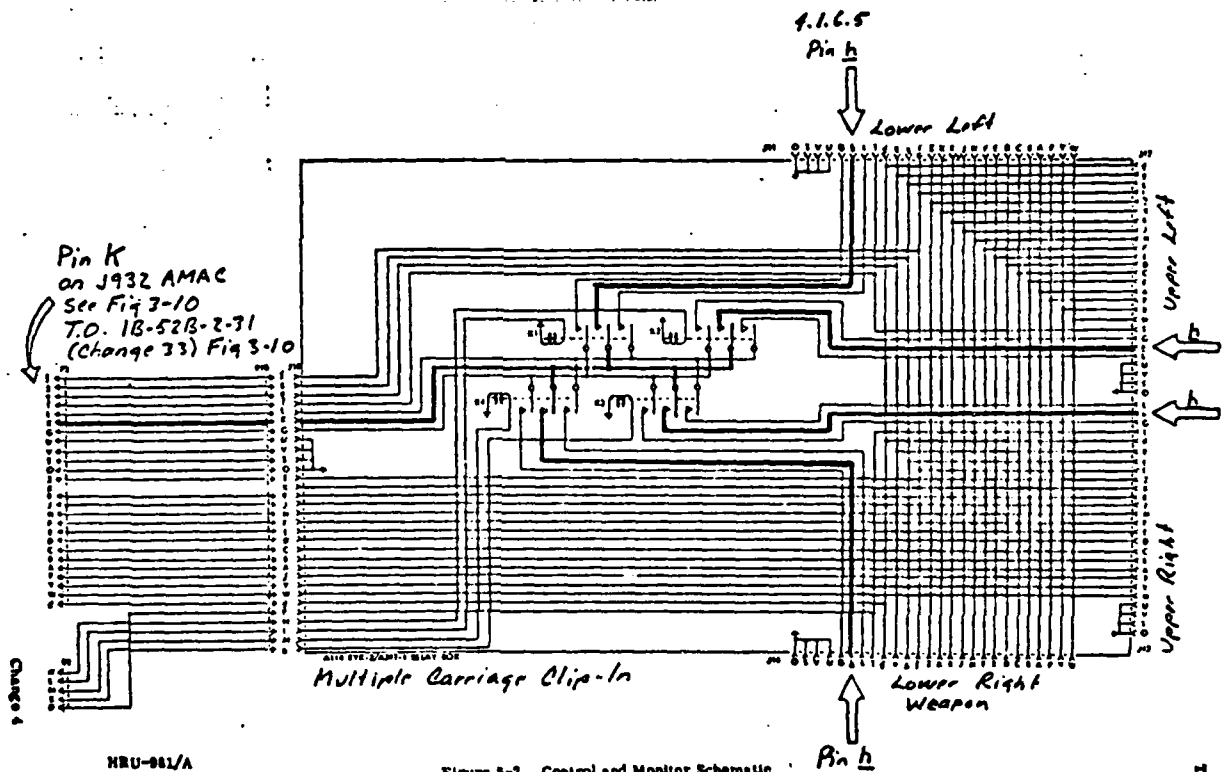


Figure 5-2.  Control and Monitor Schematic

4.1.6.5   (Continued)

a.   <u>Normal Power and Load Analysis</u>

From examination of Figure 4.1-17, Network Tree 201/248, normal open
circuit voltage = <u>OV</u>; short circuit current = <u>OA</u>.

b.   <u>Fault Analysis</u>

The following postulated faults were analyzed using Network Tree 201/248
and Figure 4.1-18, Cable Drawing.

①   <u>Clip-In Assembly or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566
during Radar Navigator testing using DCU-9/A and the SWK Box.
Relay contacts (K1, K2, K3 and K4) in A114 are only closed during
this period.  Voltage sources are shown in Figures 4.1-19 or 4.1-20.

②   <u>Connector J932/P3 or Cable 31-3516-27 Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 during testing.
Voltage source is shown on Figure 4.1-19.

③   <u>Connector J935 or Cable 31-3516-28 Damaged</u>

Connector is located in Aft Bomb Bay and is not connected and
unpowered.

④   <u>Cable 31-3516-37 Damaged</u>

Wires to subject pins shorted to 24VDC from CB1566 during testing.
Voltage source is shown on Figure 4.1-20.

⑤   <u>Cable 25-7410 or Connector P 752/J2065</u>

Wires to subject pins shorted to 24VDC from CB1565 or 28VAC from
CB544 during testing.  Voltage sources are shown on Figure 4.1-19.

⑥   <u>Cable 35-5531 Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566, or
28VAC from CB545.  Voltage sources are shown on Figures 4.1-19
and 4.1-20.

4.1.6.5b  (Continued)

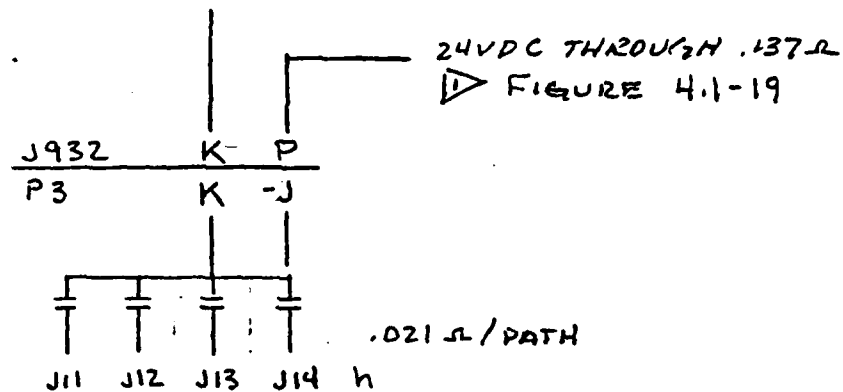⑦  <u>Readiness Switch Panel(A399) or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566 during testing.  Voltage sources are shown on Figures 4.1-19 and 4.1-20.

⑧  <u>DCU/9A Tester or Connector Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 or 28VAC from CB544.  Voltage sources are shown on Figure 4.1-19.

c. <u>Worst Case Path and Calculations</u>

Reference path①, Clip-In Assy Damaged



24VDC THROUGH .137Ω
▷ FIGURE 4.1-19

$$\frac{J932}{P3}$$ K P
K -J

J11  J12  J13  J14  h

.021 Ω / PATH

Total Resistance of Path = .158 Ω

$V_{OC}$  = 24VDC

$I_{SC} = \frac{24}{.158}$  = <u>152</u> Amps

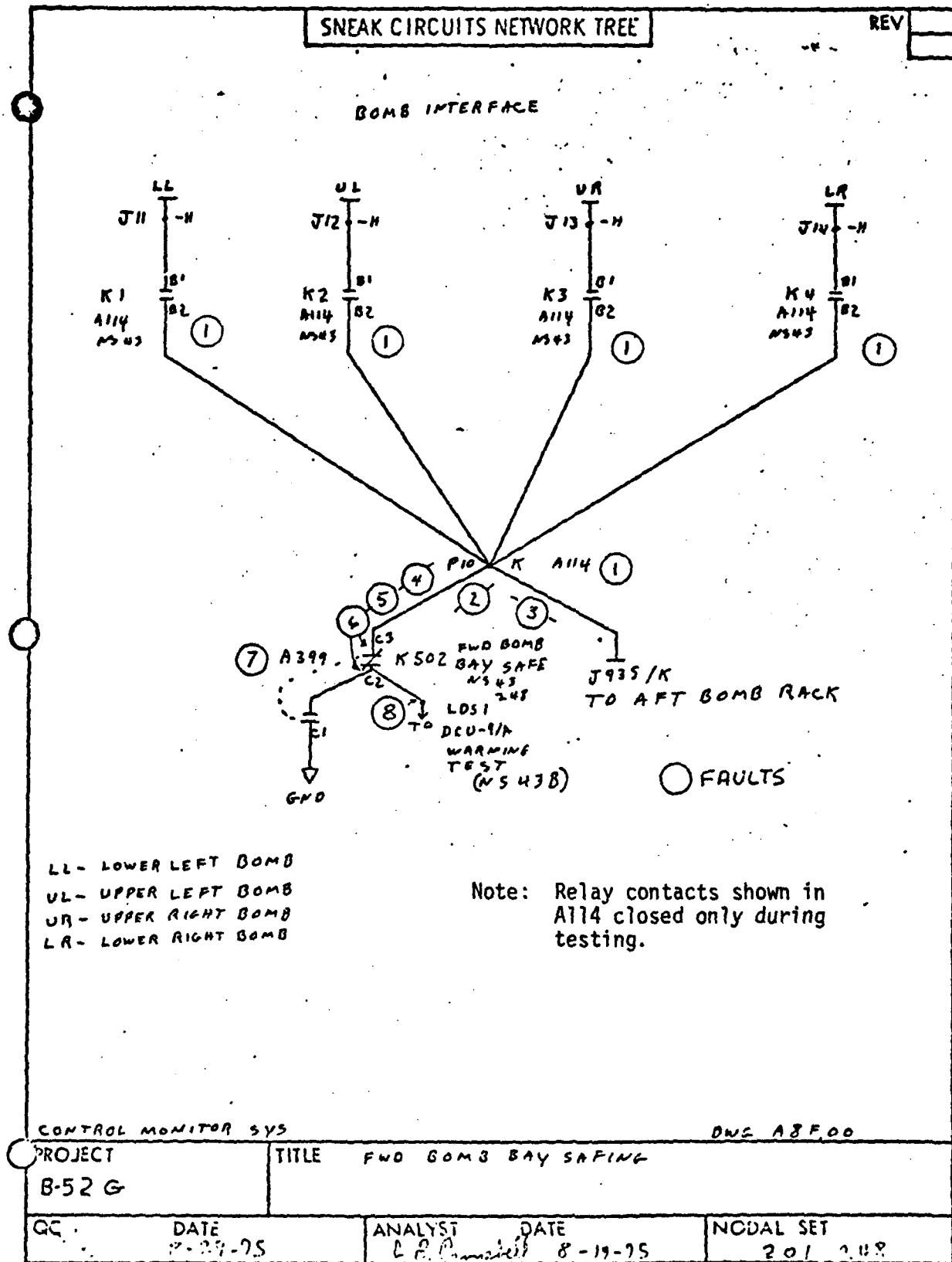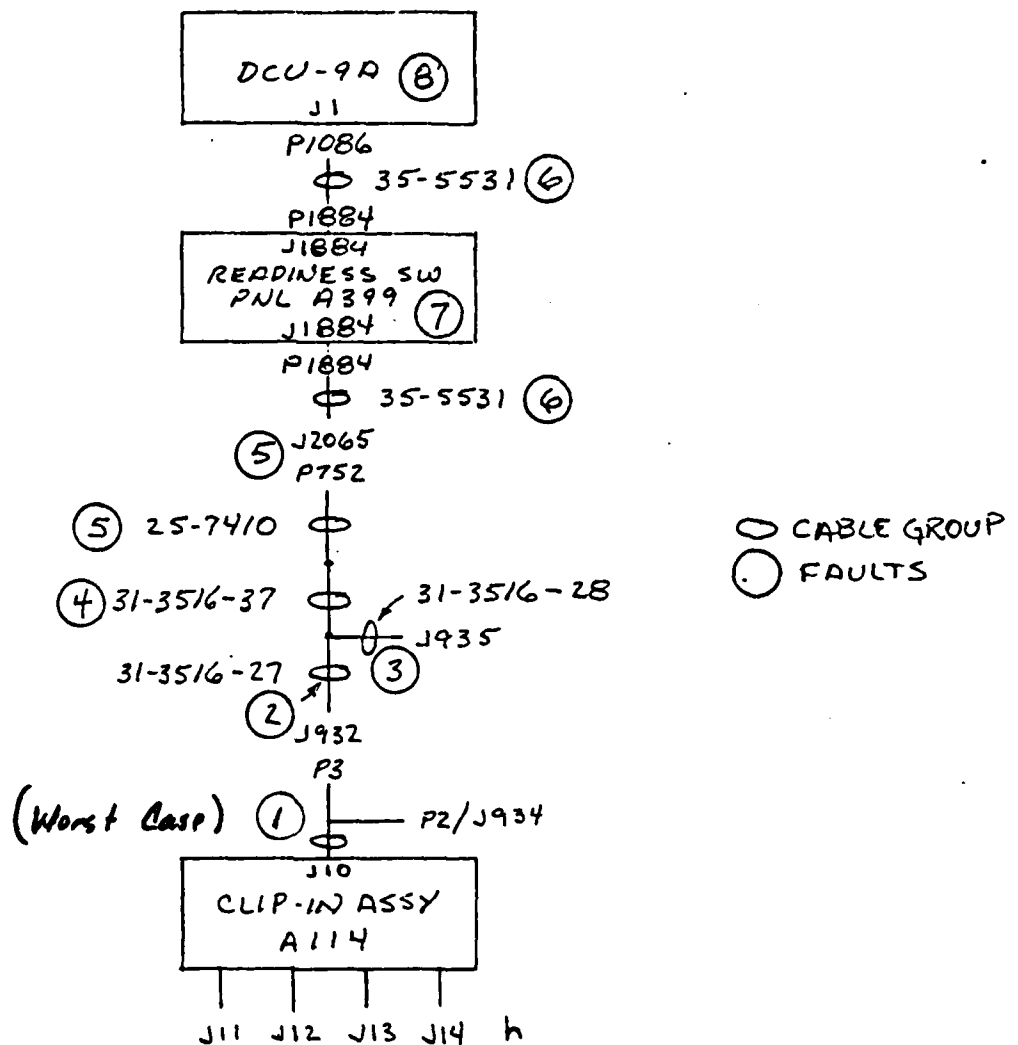Time  = Less than 0.8 seconds.  Current is greater than 1000% circuit breaker rating.

Figure 4.1-17   Network Tree No. 201/248

```
        ┌─────────────────────┐
        │   DCU-9A      ⑧      │
        │      J1             │
        └─────────────────────┘
               P1086
                 ⊖   35-5531 ⑥
               P1884
        ┌─────────────────────┐
        │      J1884           │
        │   READINESS SW       │
        │    PNL A399   ⑦      │
        │      J1884           │
        └─────────────────────┘
               P1884
                 ⊖   35-5531 ⑥
           ⑤  J2065
               P752
   ⑤  25-7410  ⬭
                            31-3516-28
   ④ 31-3516-37 ⬭      ⬭ J935
                        ③
31-3516-27 ⬭
        ② J932
               P3
(Worst Case) ①      P2/J934
               ⬭
               J10
        ┌─────────────────────┐
        │   CLIP-IN ASSY       │
        │      A114            │
        └─────────────────────┘
          │    │    │    │
         J11  J12  J13  J14   h
```

⊖ CABLE GROUP
◯ FAULTS

CABLE DRAWING

FIGURE 4.1-18

A114 CLIP-IN ASSY

| LL | J11 |
| UL | J12 |
| UR | J13 |
| LR | J14 |

① CABLE WITH P2

P3
J932 ② E E / P J / A R

A399 READINESS SW PNL
.010Ω ⑦
J1884
P1884

CABLE 31-3516-27

.069Ω  .044Ω  .176Ω

R  .010Ω  .055Ω  .014Ω  M  ⑧
J  .055Ω  .004Ω  J
U  .055Ω  U

⑥

L  .008Ω  L  .008Ω  L
K  .008Ω  K  .008Ω  K
A  A  .018Ω  A

SAFE
.010Ω
DCU-9/A TESTER

P1086
J1

CABLE 35-5531

P752
J2065 ⑤

CABLE 25-7410

IFC SW S6217  .010Ω

.012Ω  .012Ω
.013Ω

A174 AFT BUS CR PNL
24VDC CB1565 15A
28VAC CB544 5A

① Paragraph C (Worst Case)

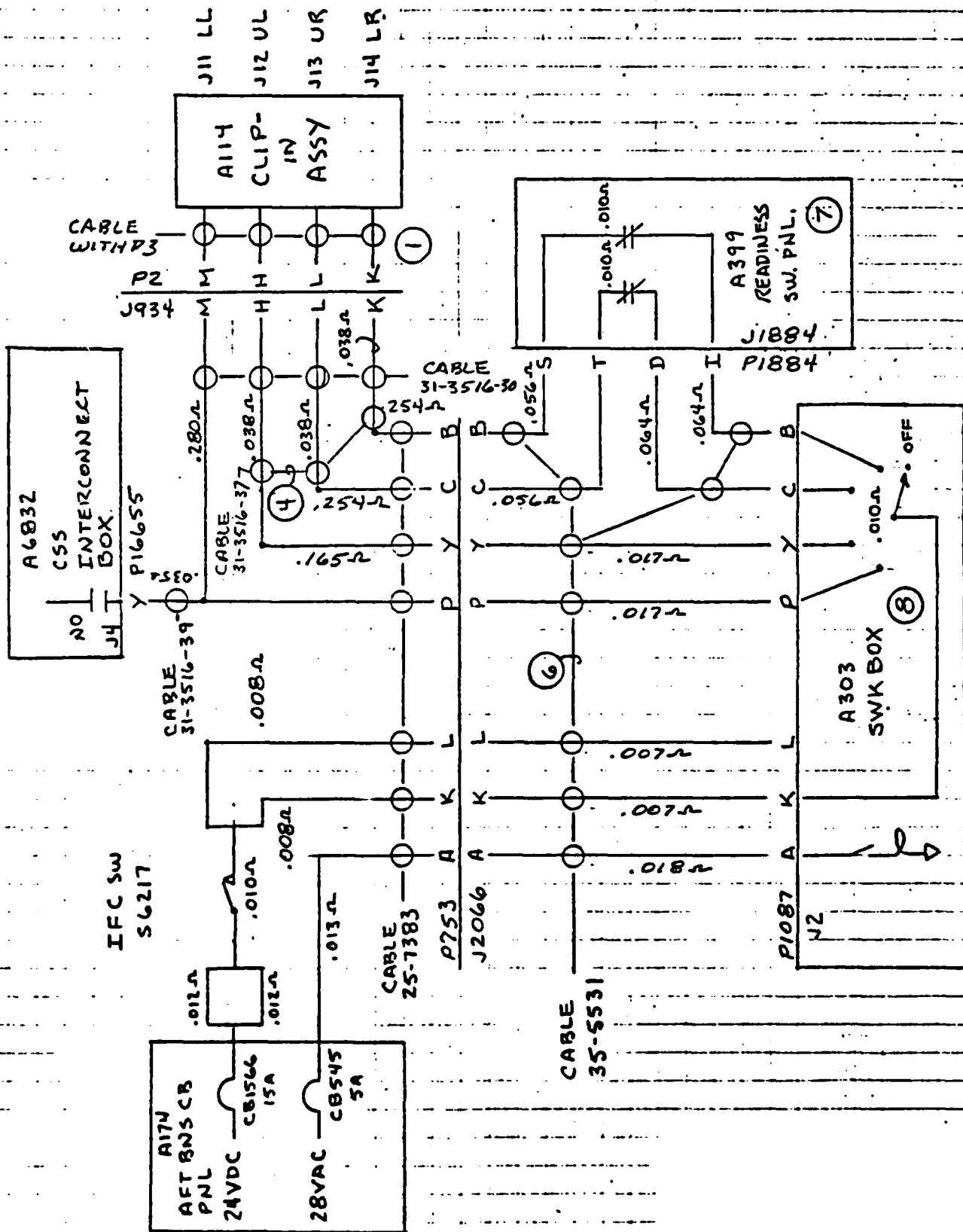Figure 4.1-19  Power Paths Through DCU-9/A Tester

Figure 4.1-20 Power Paths Through SWK Box

## CLIP-IN ASSEMBLY PINS
## F, H, J & c
## CIRCUIT ANALYSIS PACKAGE

4.1.6.6    Circuit Analysis Package, Weapon Interface Pins F, H, J & c of
Connectors J11, J12, J13 and J14 on A114 Clip-In Assembly and
Cable in Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (Change 4) - copy
attached below.  Maximum current available to these pins in a normal environ-
ment is 0 amps.  Worst case current at 24VDC in an abnormal (faulted) environ-
ment assuming the pins grounded at the weapon interface would be 109 amps for
pins F, J & c and 0 amps on pin H.  The only fault that can supply current to
pin H occurs during Radar Navigator Testing using the DCU-9/A.  In this case 150
amps could be supplied but only for a brief period.  This may result when the
Clip-In Assembly is damaged.



Figure 5-2.  Control and Monitor Schematic
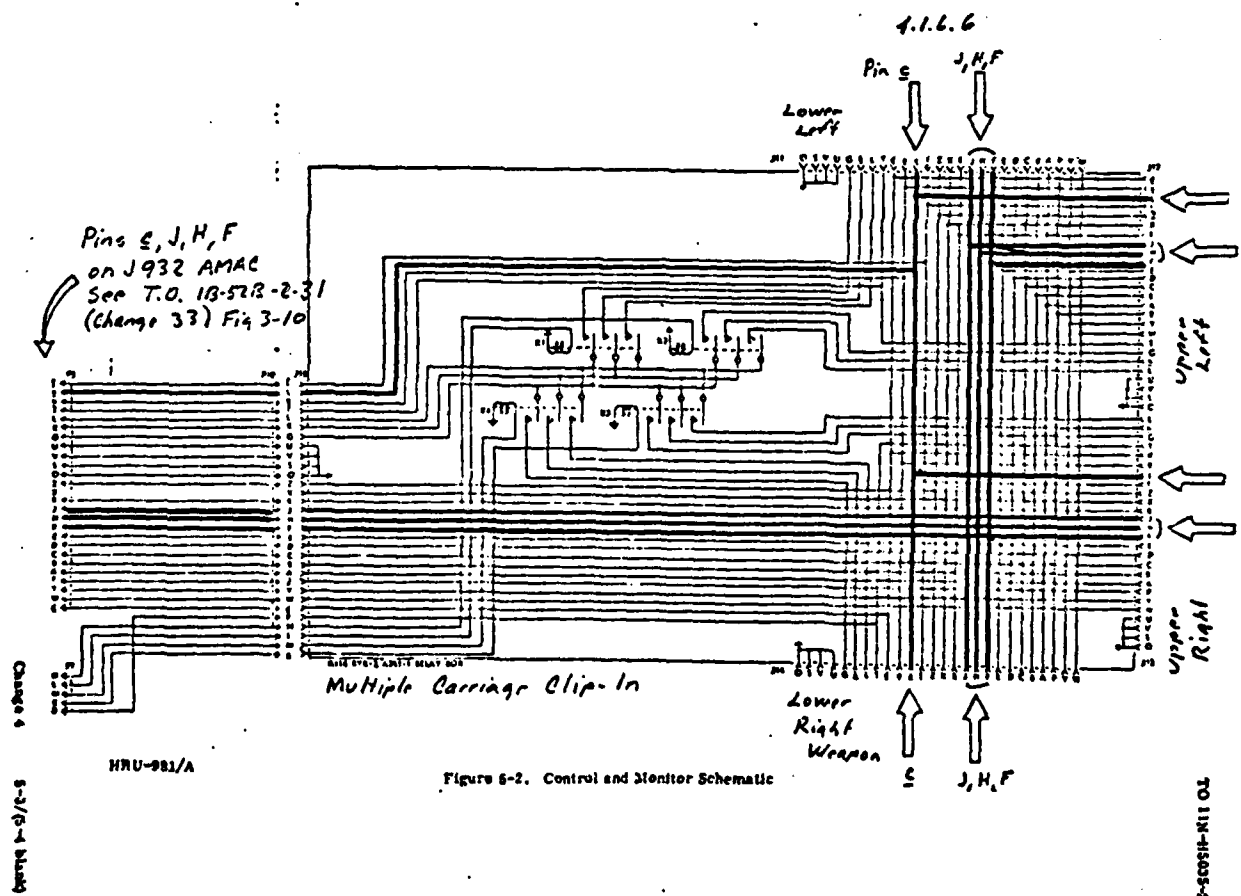
4.1.6.6   (Continued)

a.   Normal Power and Load Analysis

From examination of Figure 4.1-21, Network Tree 0199, normal open circuit voltage = 0V; Short circuit current = 0A.

b.   Fault Analysis

The following postulated faults were analyzed using Network Tree 0199 and Figure 4.1-22, Cable Drawing.

①   Clip-In Assembly or Connector Damaged

Wires to subject pins shorted to 24VDC from CB1565 or CB1566 during testing using DCU-9/A and SWK Box.  Voltage sources are shown on Figures 4.1-23 and 4.1-24.

②   Connector J932/P3 or Cable 31-3516-27 Damaged

Wires to subject pins shorted to 24VDC from CB1565 during testing. Voltage source is shown on Figure 4.1-23.

③   Cable 25-7410 or Connector P752/J2065 Damaged


Wires to subject pins shorted to 24VDC from CB1565 or 28VAC from CB544.  Voltage sources are shown on Figure 4.1-23.

④   Cable 35-5531 Damaged

Wires to pins F, J & c shorted to 24VDC prom CB1565 or CB1566 or 28VAC from CB544 and CB545.  Voltage sources are shown on Figures 4.1-23 and 4.1-24.

⑤   DCU-9/A Testor or Connector Damaged

Wires to pins F, J & c shorted to 24VDC from CB1565 or 28VAC from CB544.  Voltage sources are shown on Figure 4.1-23.

⑥   Cable 31-3516-28 or Connector J935 Damaged

Cable to Aft Bomb Bay is not connected and unpowered, (common with wire to Pin F).

4.1.6.6   (Continued)

⑦   <u>Cable 31-3516-37 Damaged</u>

Wire to pin F shorted to 24VDC from CB1566 during testing.   Voltage
source is shown in Figure 4.1-24.

⑧   <u>Cable 31-3516-35 Damaged</u>

Cable to CSS Interconnect Box does not normally contain voltage sources.
(common with wires to pins F & H).

⑨   <u>Cable 31-3516-1</u>

Cable from CSS Interconnect Box to Bomb Bay connectors does not
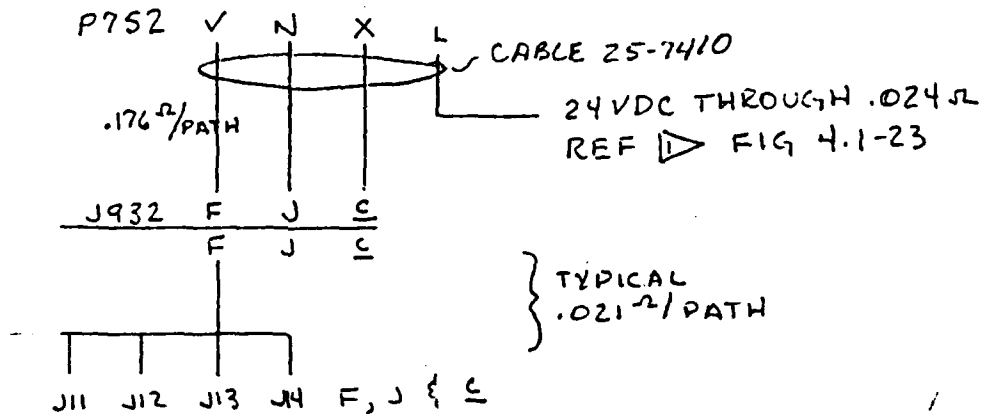normally contain voltage sources.   (Common with wires to Pins F&H)

⑩   <u>CSS Interconnect Box Damaged</u>

Wire to pins F & H shorted to 24VDC from CB1566.   Voltage source
is shown in Figure 4.1-24.

4.1.6.6 (Continued)

c. Worst Case Paths

Pins F, J & c
Reference Path③, Cable 25-7410 or Connector P752/J2065 Damaged.



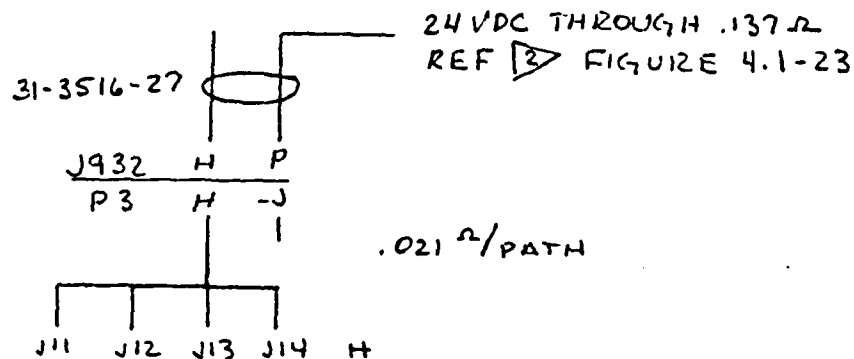Total resistance of path = .221 $\Omega$

$V_{OC}$ = 24VDC

$I_{SC} = \dfrac{24}{.221} = \underline{109}$ A

Time = 1.2 seconds maximum for CB to open.

4.1.6.6c  (Continued)

Pin H

Reference Path①, Clip-In Assembly or Connectors Damaged.



Total Resistance of Path .158 Ω

$V_{OC}$ = 24VDC*

$I_{SC}$*= $\dfrac{24}{.158}$ = __150__ A

Time = 0.8 seconds maximum for CB to open.

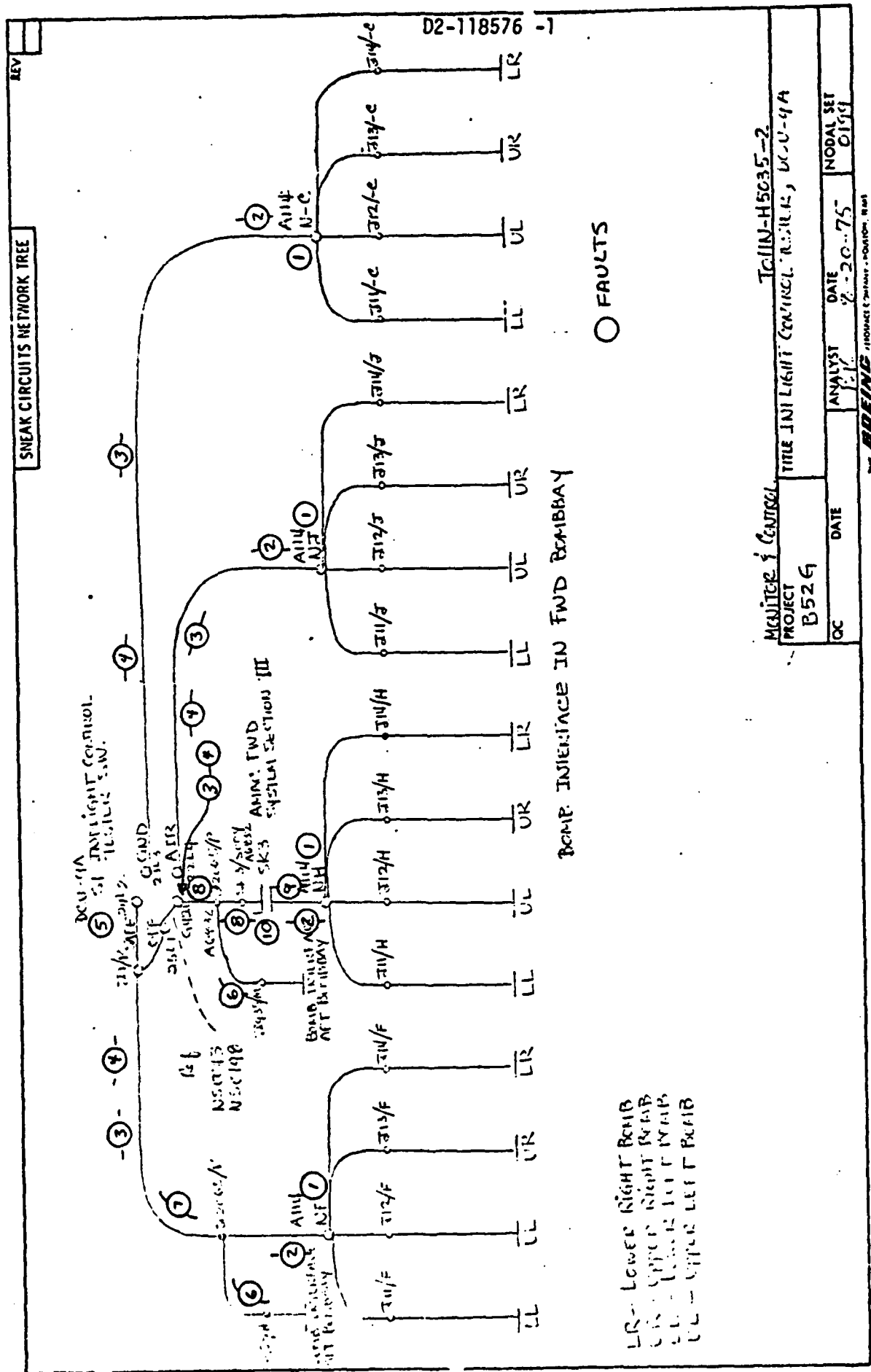* Voltage present when DCU-9/A in "SAFE"

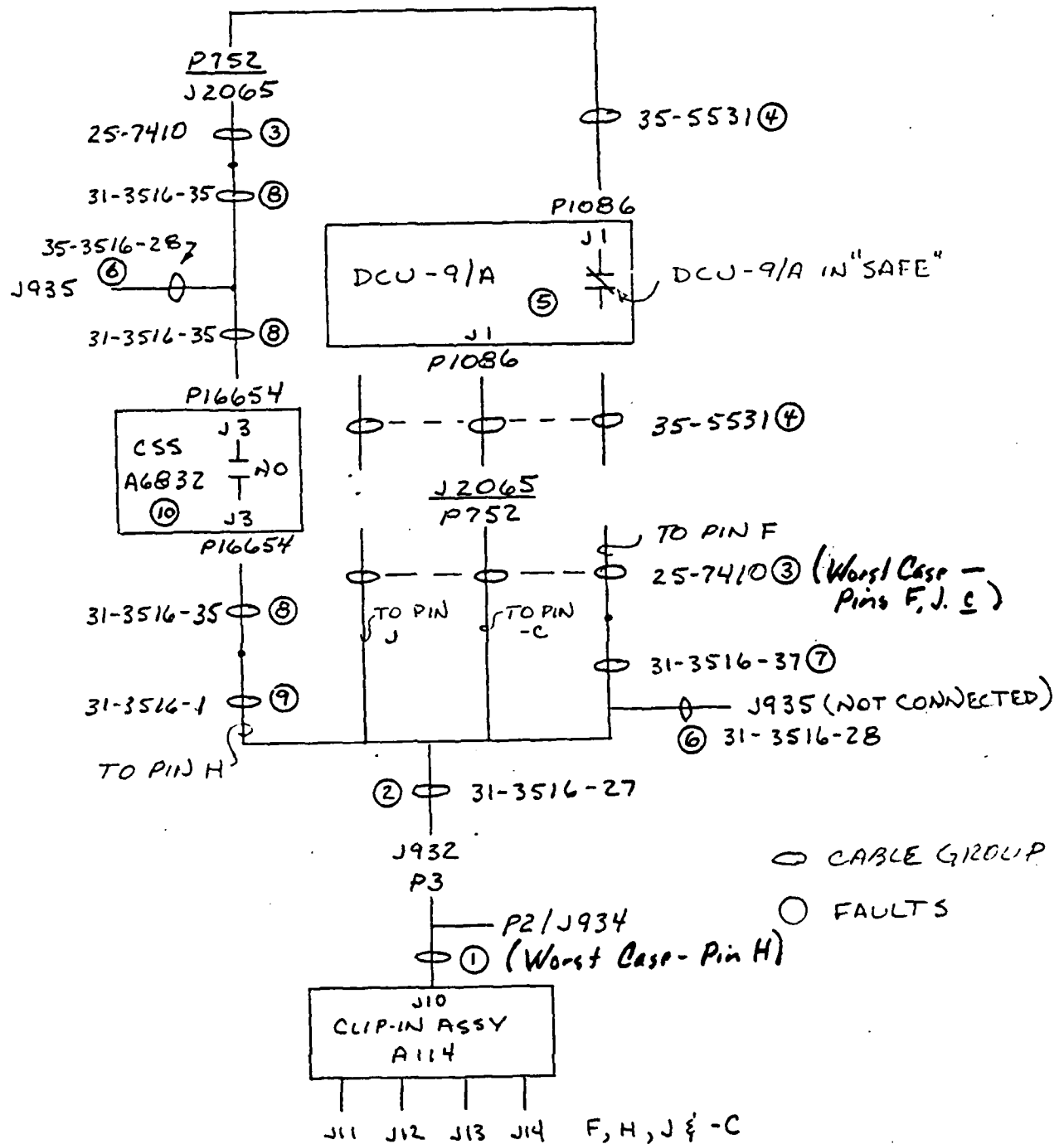Figure 4.1-21  Network Tree No. 0199

FIGURE 4.1-22

CABLE DRAWING
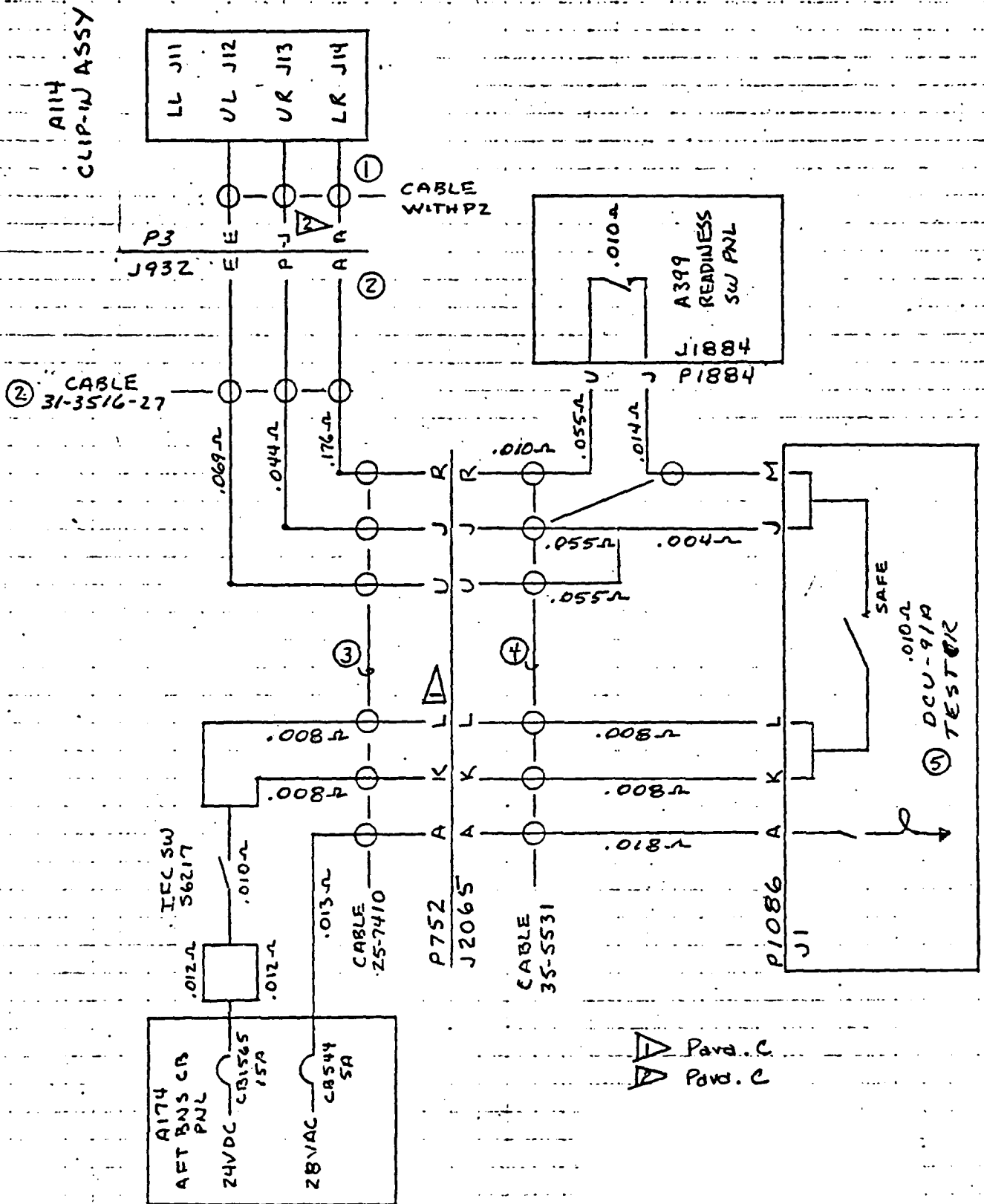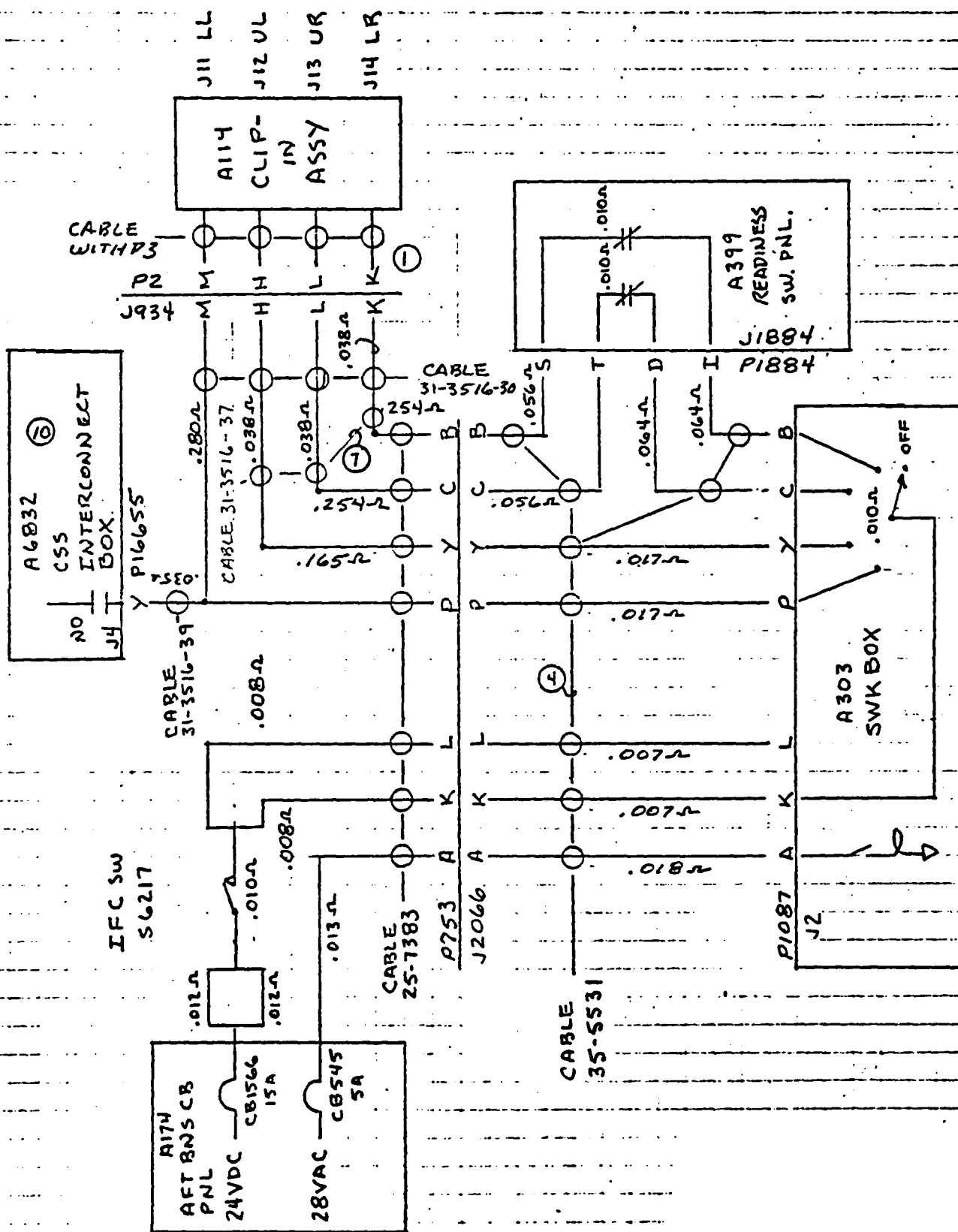
Figure 4.1-23  Power Paths Through DCU-9/A Tester

Figure 4.1-24 Power Paths Through SWK Box

CLIP-IN ASSEMBLY PINS

P, E, G, L, D, B, A & R

CIRCUIT ANALYSIS PACKAGE

4.1.6.7    Circuit Analysis Package, Weapon Interface Pins P, E, G, L, D,
           B, A & R of Connectors J11, J12, J13 and J14 on A114 Clip-In
           Assembly and Cable in Forward Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2 (Change 4) - copy
attached below. Maximum short circuit current available to these pins in a
normal environment is 0 amps. When the DCU-9/A is switched to "SAFE", a test
mode, short circuit current to Pin P is 152 amps, Pin E is 131 amps and Pin A
is 75 amps at 24VDC. Worst case current at 24V in an abnormal environment to
Pin P would be 258 amps, Pin E would be 211 amps, and Pin A would be 109 amps.
Worst case fault current for Pins G, L, D, B & R would be 152 amps at 24V.



Figure 5-2. Control and Monitor Schematic
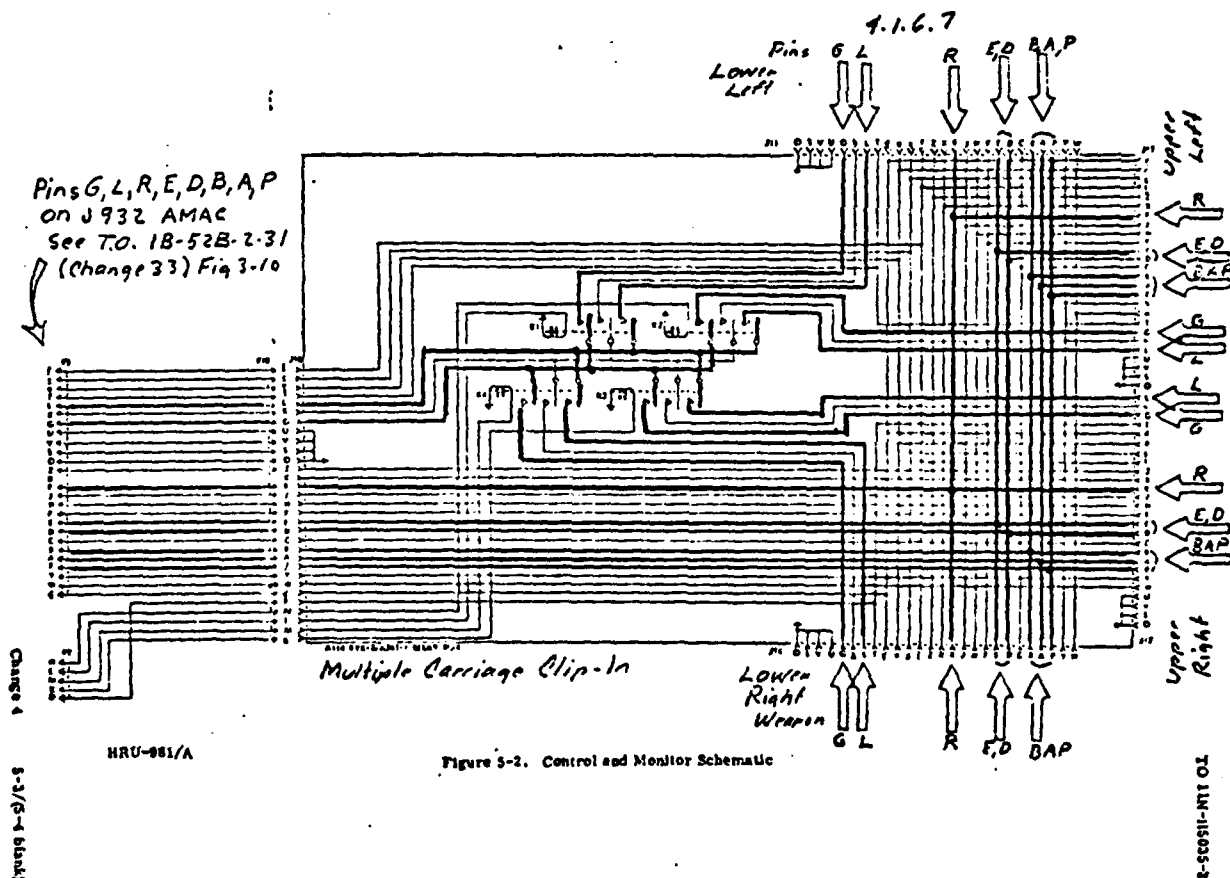
4.1.6.7    (Continued)

Worst case current at 24VDC in an abnormal (faulted) environment assuming the pins grounded would be:

Pin P - 258 Amps
E - 211 Amps
A - 109 Amps
G - 152 Amps - current available only when DCU-9/A is in "SAFE"
L - 152 Amps - current available only when DCU-9/A is in "SAFE"
D - 152 Amps - current available only when DCU-9/A is in "SAFE"
B - 152 Amps - current available only when DCU-9/A is in "SAFE"
R - 152 Amps - current available only when DCU-9/A is in "SAFE"

a.    Normal Power and Load Analysis

From examination of Figure 4.1-25, Network Tree 43B, open circuit voltage for all subject pins would be = $\underline{0}$ amps.  Short circuit current = $\underline{0A}$. With DCU-9/A switched to "SAFE", a test mode, a power path is established as shown in Figure 4.1-27, open circuit voltage and short circuit current for pins P, E and A in this mode would be:

Pin P

Total Resistance of path = .158 $\Omega$
$V_{OC}$ = 24VDC
$I_{SC} = \dfrac{24}{.158} = \underline{152}$ A

Pin E

Total Resistance of path = .183 $\Omega$
$V_{OC}$ = 24VDC
$I_{SC} = \dfrac{24}{.183} = \underline{131}$ A

Pin A

Total Resistance of path = .320 $\Omega$
$V_{OC}$ = 24VDC
$I_{SC} = \dfrac{24}{.320} = \underline{75}$ A

b.    Fault Analysis

The following postulated faults were analyzed using Network Tree 43B and Figure 4.1-26, Cable Drawing.

4.1.6.7b  (Continued)

&#9312;  <u>Clip-In Assembly or Cable Damaged (Worst Case - Pins G & L)</u>

Wires to subject pins shorted to 24VDC from CB1565 or CB1566 during testing with DCU-9/A tester and SWK Box.  Voltage sources are shown on Figures 4.1-27 and 4.1-28.

&#9313;  <u>Cable 31-3516-27 or Connector J932/P3 (Worst Case - Pins D, B &R)</u> <u>Damaged</u>

Wires to subject pins shorted to 24VDC from CB1565 during testing. Voltage source is shown on Figure 4.1-27.

&#9314;  <u>Cable 31-3516-1 Damaged</u>

Cable runs between CSS and weapons interface.  The CSS is normally open therefore no voltage potentials are present.  This cable is common with wires to pins B, D & R.

&#9315;  <u>CSS Interconnect Box (A6832) or Connectors Damaged</u>

Wires to pins B, D & R shorted to 24VDC from CB1566 during testing. Voltage source is shown on Figure 4.1-28.

&#9316;  <u>Cable 31-3516-35 Damaged</u>

Cable to CSS Interconnect Box (A6832) does not normally contain voltage sources (common with wire to pin R).

&#9317;  <u>Cable 31-3516-28 Damaged</u>

Cable to Aft Bomb Bay is open and does not contain voltage sources (common with wire to pin L).

&#9318;  <u>Cable 31-3516-37 Damaged</u>

Wire to pin L shorted to 24VDC from CB1566 during testing.  Voltage source is shown on Figure 4.1-28.

&#9319;  <u>Cable 25-7410-or Connector P752/J2065 Damaged (Worst Case-pins P,E & A)</u>

Wires to pins A, E, G, L & P shorted to 24VDC from CB1565 or 28VAC from Voltage sources are shown on Figure 4.1-27.

⑨ <u>Cable 35-5531 Damaged</u>

Wires to pins A, E, G, L & P shorted to 24VDC from CB1565 or CB1566, or 28VAC from CB544 or CB545. Voltage sources are shown on Figures 4.1-27 or 4.1-28.

⑩ <u>DCU-9/A Tester or Connector Damaged</u>

Wires to pins A, E, G, L & P shorted to 24VDC from CB1565 or 28VAC from CB544. Voltage sources are shown on Figure 4.1-27.
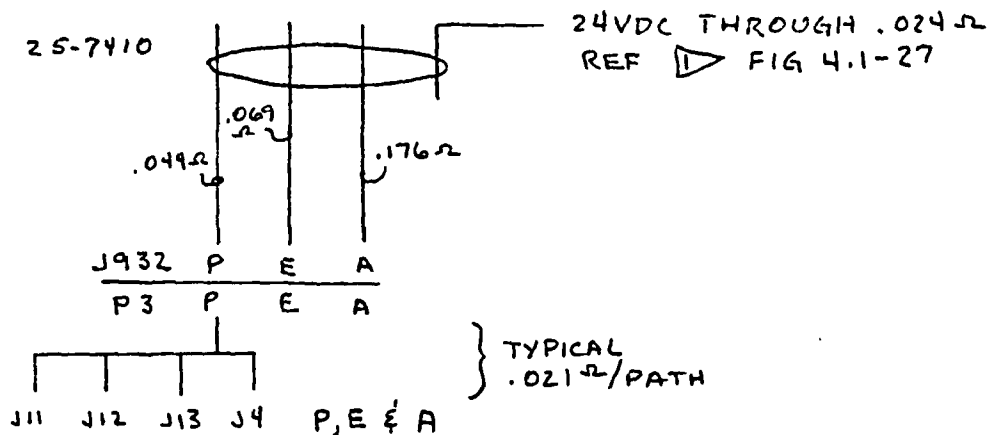
⑪ <u>Readiness Switch Panel (A399) or Connector Damaged</u>

Wires to pins G, L & A shorted to 24VDC from CB1565 or CB1566 during testing. Voltage sources are shown on Figures 4.1-27 and 4.1-28.

4.1.6.7    (Continued)

c.    Worst Case Paths

Pins P, E & A Reference Path ⑧ Cable 25-7410 Damaged.



Pin P    Total resistance of path = .089 $\Omega$

V$_{OC}$ = 24VDC

I$_{SC}$ = $\dfrac{24}{.089}$ = 258 A

Time =  Less than 0.8 seconds.  Current exceeds 1000% rating of CB.

Pin E    Total resistance of path = .114 $\Omega$

V$_{OC}$ = 24VDC

I$_{SC}$ = $\dfrac{24}{.114}$ = 211 A

Time =  Less than 0.8 seconds.  Current exceeds 1000% rating of CB.

Pin A    Total resistance of path = .221 $\Omega$

V$_{OC}$ = 24VDC

I$_{SC}$ = $\dfrac{24}{.221}$ = 109 A

Time = Less than 1.4 seconds.

4.1.6.7c (Continued)

Pins G & L Reference Path①Clip-In Assembly Damaged

24VDC* THROUGH .137 Ω
REFERENCE ▷ 4.1-27

J932        P
P3         -J

K

CLIP IN ASSY

JII  JIL  JI3  JIY  G & L

} TYPICAL
.021 Ω/PATH

Total Resistance of Path = .158 Ω

$V_{OC}$ = 24VDC

$I_{SC} = \dfrac{24}{.158} = \underline{152}$ A

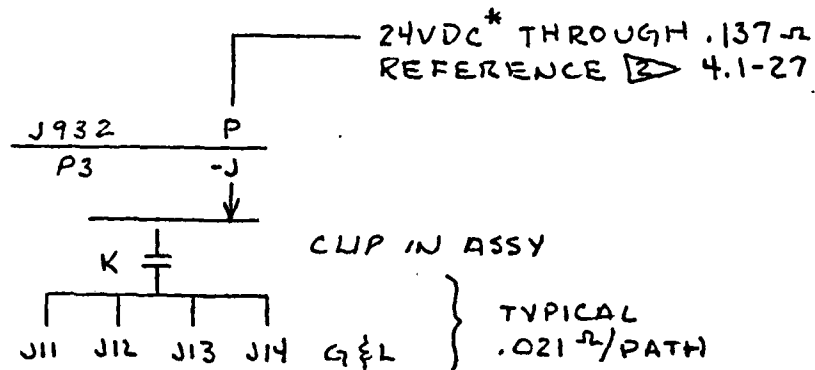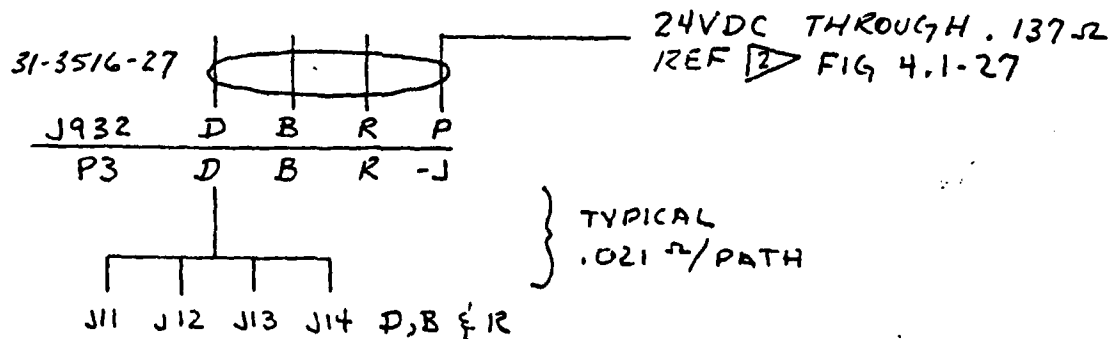Time = Less than 0.8 seconds.  Current exceeds 1000% rating of CB.

Note:  Relay K closed only when SWK Box is in "UL", "LL", "UR" or "LR".

Pins D, B & R Reference Path②Cable 31-3516-27 or Connector J932/P3
Damaged.

24VDC THROUGH .137 Ω
REF ▷ FIG 4.1-27

31-3516-27

J932    D    B    R    P
P3      D    B    R   -J

} TYPICAL
.021 Ω/PATH

JII  JI2  JI3  JIY  D, B & R

4.1.6.7c  (Continued)

Total Resistance of Path = .158 $\Omega$

$V_{OC}$ = 24VDC

$I_{SC}$ = 152 A

Time = Less than 0.8 seconds.   Current exceeds 1000% rating of CB.

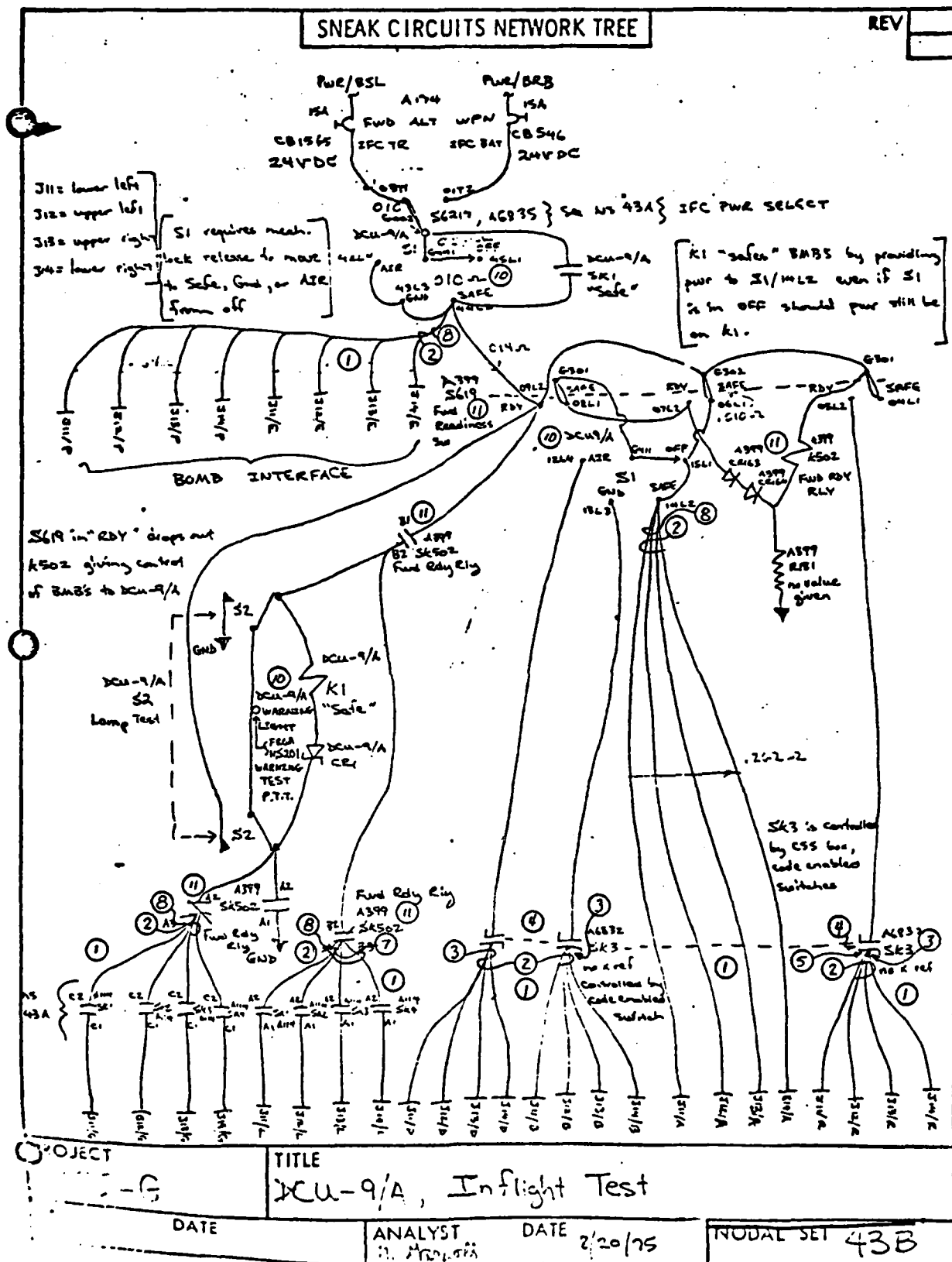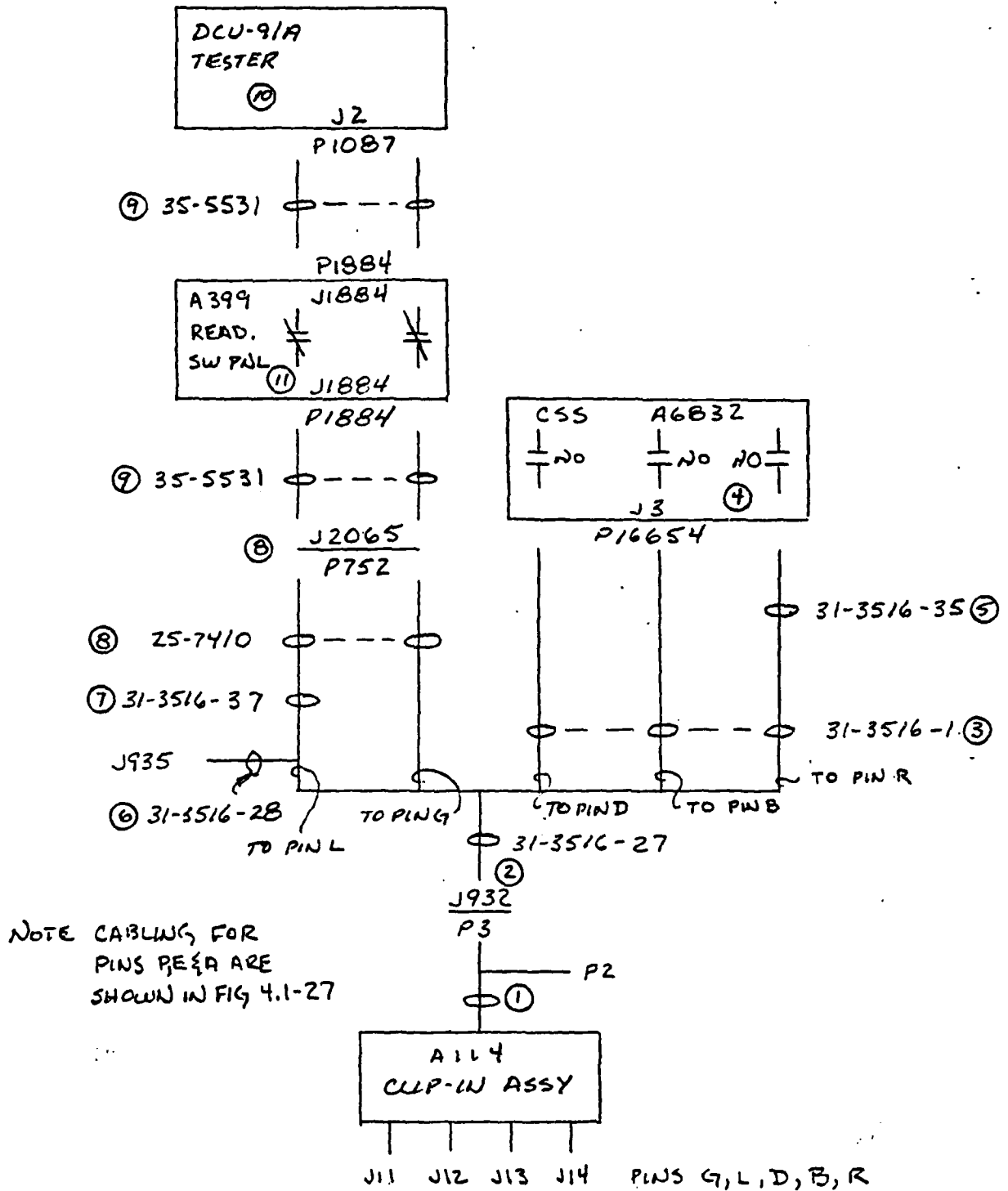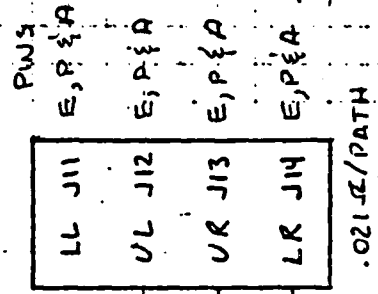* Voltage source is present only when DCU-9/A is in "SAFE" during Radar Navigator Testing.

Figure 4.1-25  Network Tree No. 43B

CABLE DRAWING

FIGURE 4.1-26
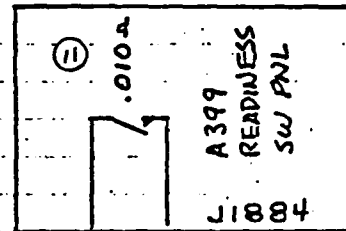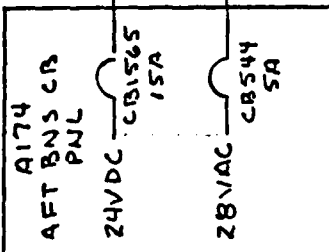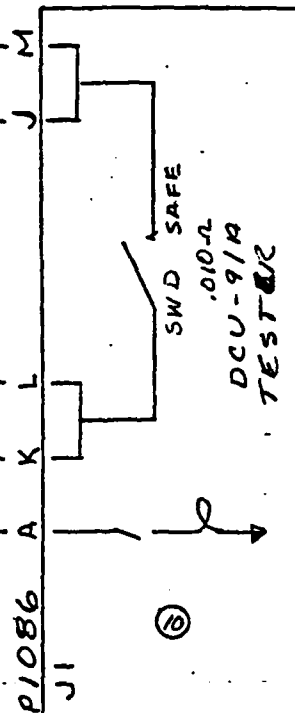
Figure 4.1-27 Power Paths Through DCU-9/A Tester
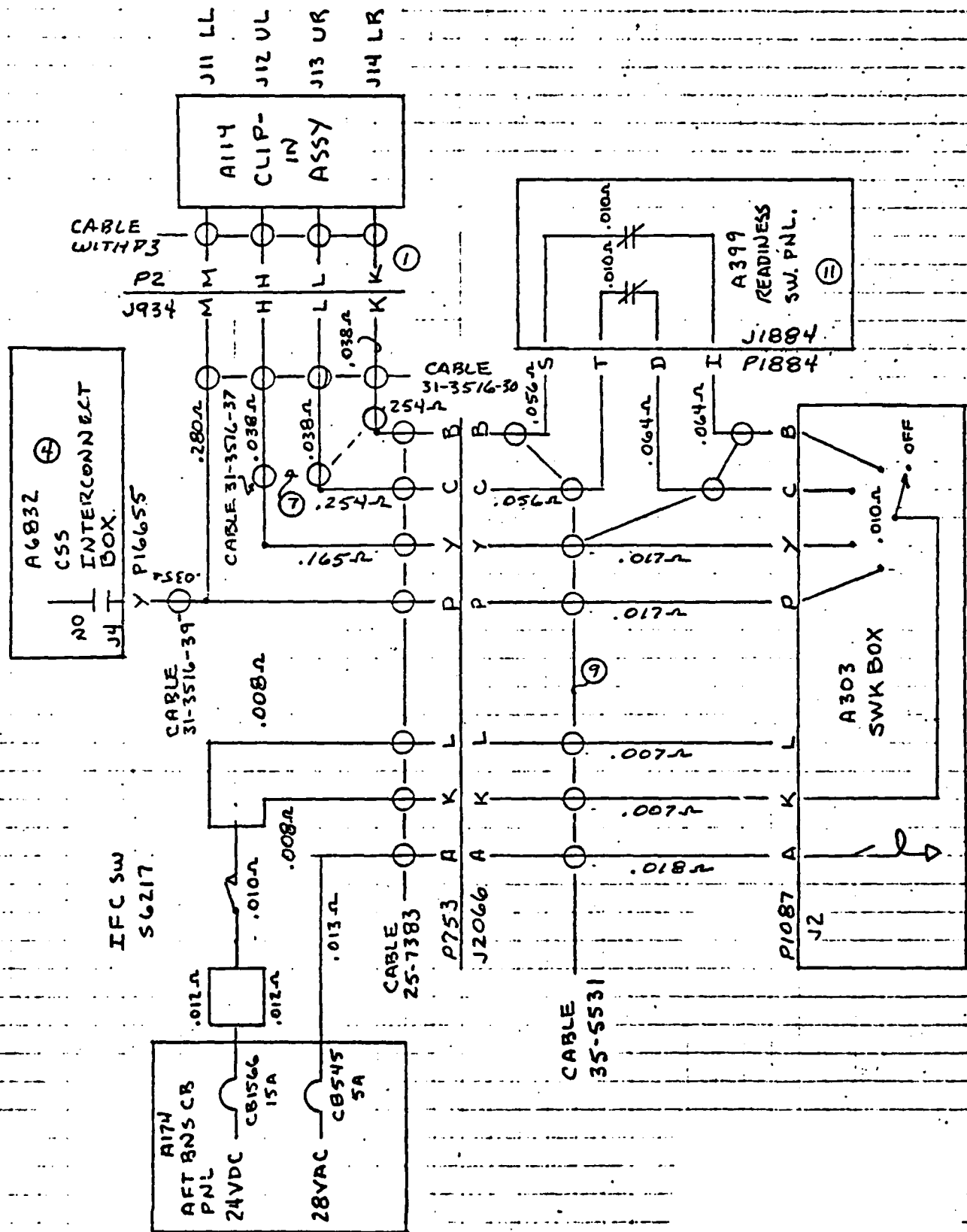
Figure 4.1-28  Power Path Through SWK Box

## CLIP-IN ASSEMBLY PIN X
## CIRCUIT ANALYSIS PACKAGE

4.1.6.8   Circuit Analysis Package, Weapon Interface Pin X on Connectors J11,
J12, J13 and J14 of the Clip-In Assembly and Cable in the Forward
Bomb Bay

These interfaces are shown in Figure 5-2, T.O. 11N-H5035-2, (Change 4) - copy
attached below.  Maximum current available to pin X in a normal environment is
0 amps.  Worst case current in an abnormal (faulted) environment would be 152
amps assuming the pins grounded at the weapon interfaces when current is avail-
able through the DCU-9/A tester (a test mode).



Figure 5-2.  Control and Monitor Schematic
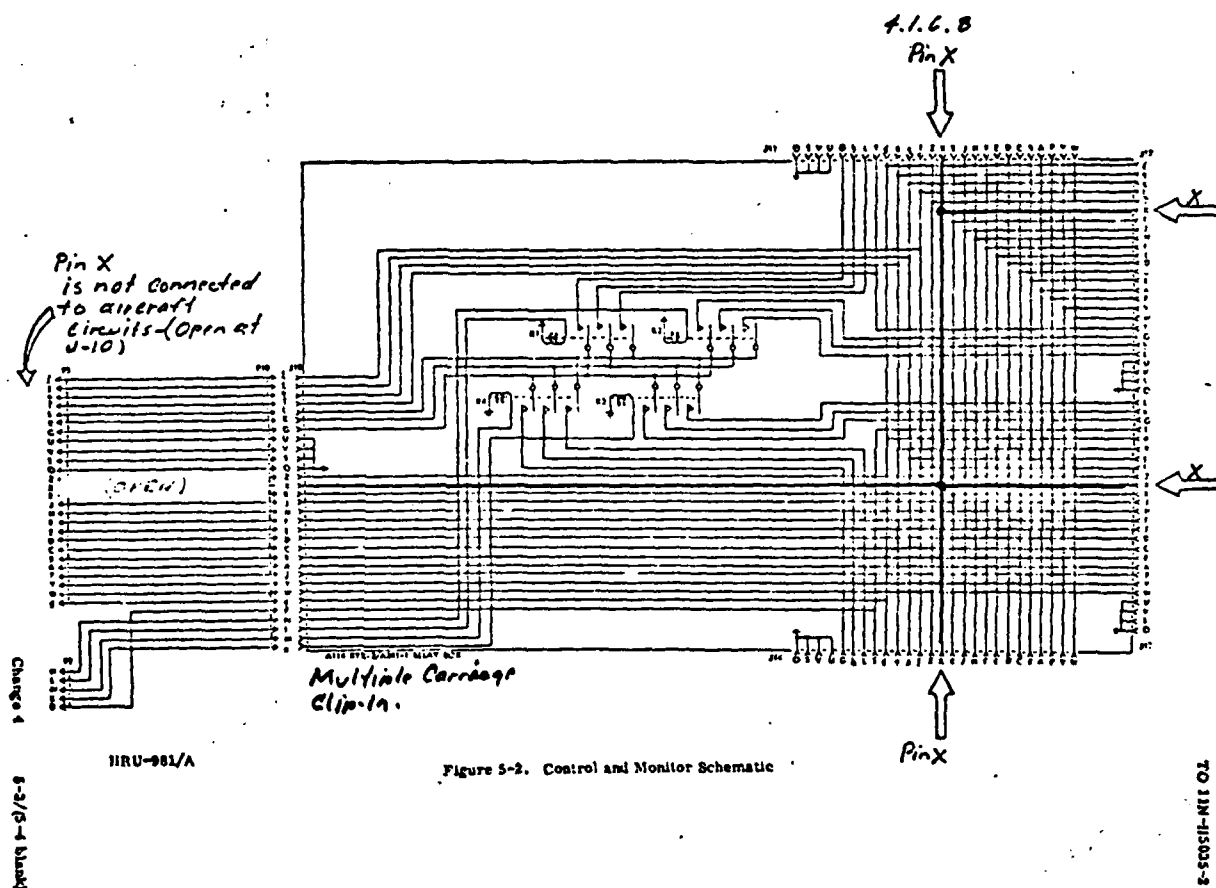
4.1.6.8    (Continued)

a.    Normal Power and Load Analysis

From examination of Figure 4.1-29, Network Tree 202, open circuit voltage for pin X is = $\underline{0V}$.   Short circuit current = $\underline{0A}$.   This circuit is not connected to the aircraft.   The cable between A114 Clip-In Relay Box and J932 AMAC has no wire to pin X.

b.    Fault Analysis

The following postulated fault was analyzed using Network Tree 202.

①    Clip-In Assembly Damaged (Worst Case)

Wires to pin X shorted to 24VDC from CB1565 or CB1566 during testing using the DCU-9/A and the SWK Box.   Voltage sources as shown in Figures 4.1-30 and 4.1-31.

4.1.6.8    (Continued)

c.   <u>Worst Case Fault</u>

①  Clip-In Assembly Damaged
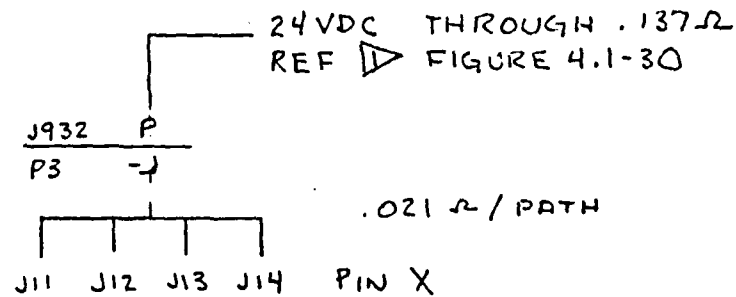
24VDC  THROUGH  .137 Ω
REF ▷ FIGURE 4.1-30

J932    P
P3      -1

.021 Ω / PATH

J11   J12   J13   J14    PIN X

Total Resistance of Path = .158 Ω

$V_{OC}$ = 24VDC

$I_{SC}$ = <u>152</u> A

Time =  Less than 0.8 seconds.  Current exceeds 1000% CB rating.

| SNEAK CIRCUITS NETWORK TREE | REV |
|---|---|

OPEN
P10 X

①

J12 ● X    J11 ● X    J13 ● X    J14 ● X

UL    LL    UR    LR

BOMB INTERFACE

LL - LOWER LEFT WEAPON
UL - UPPER LEFT WEAPON
UR - UPPER RIGHT WEAPON
LR - LOWER RIGHT WEAPON

REF. DES A114
◯ FAULT

MONITOR CONTROL SYS

DWG. TO 11N-A5035-2

| PROJECT | TITLE | UNUSED CIRCUITRY | |
|---|---|---|---|
| B-52G | | | |
| QC | DATE 8-21-75 | ANALYST DATE L.B. Campbell 8-20-75 | NODAL SET 202 |

HOU-205                    AEROSPACE DIVISION - HOUSTON, TEXAS

Figure 4.1-29  Network Tree 202

Figure 4.1-30  Power Paths Through DCU-9/A Tester

Figure 4.1-31  Power Paths Through SWK Box

## 4.1.7    Circuit Analysis Packages - B52/AGM-69A

The following packages present the power and load analyses of AGM-69A arming circuits on the launcher or pylon.  Some packages describe the circuit for both the launcher and pylon while other packages describe separate circuits.

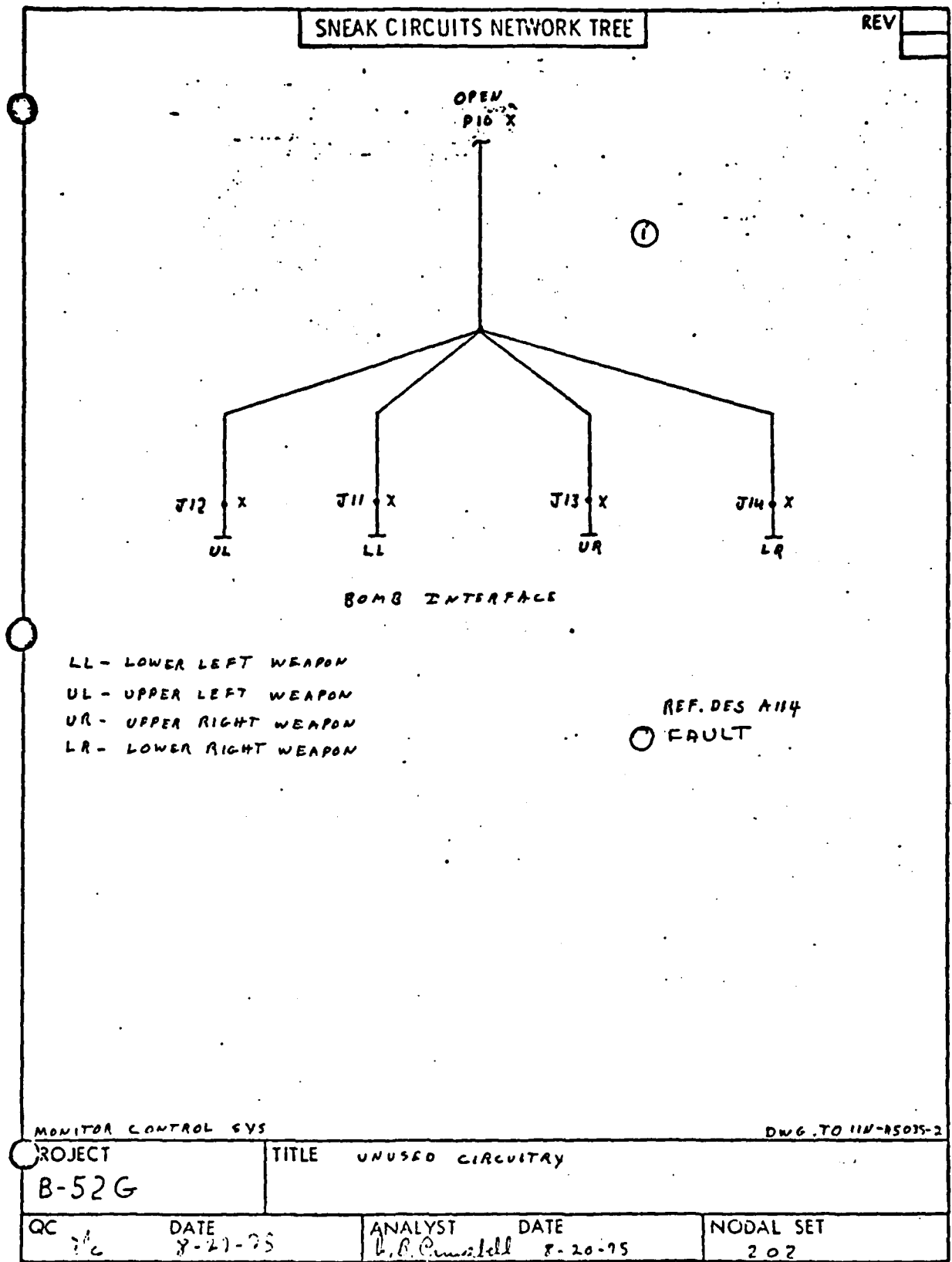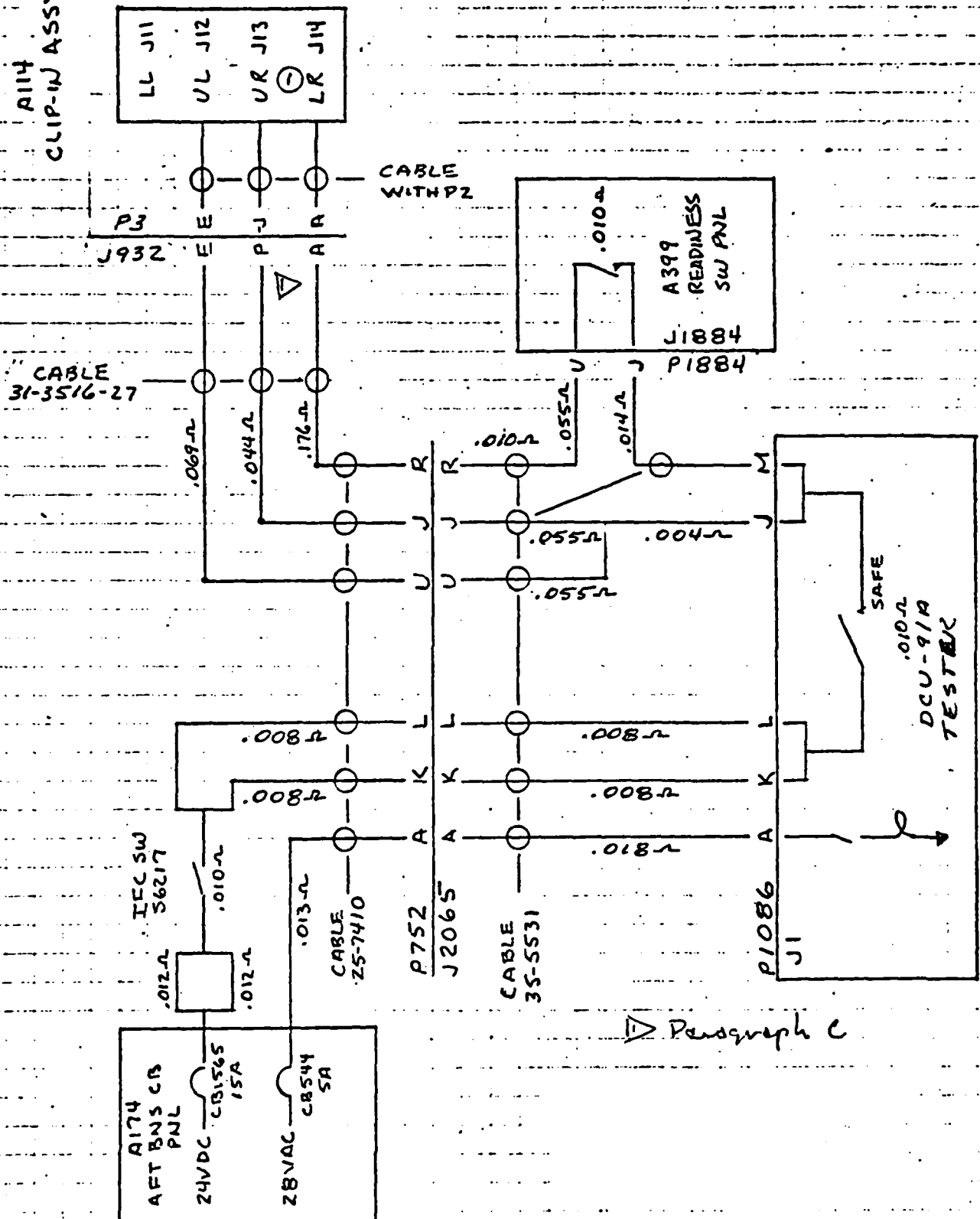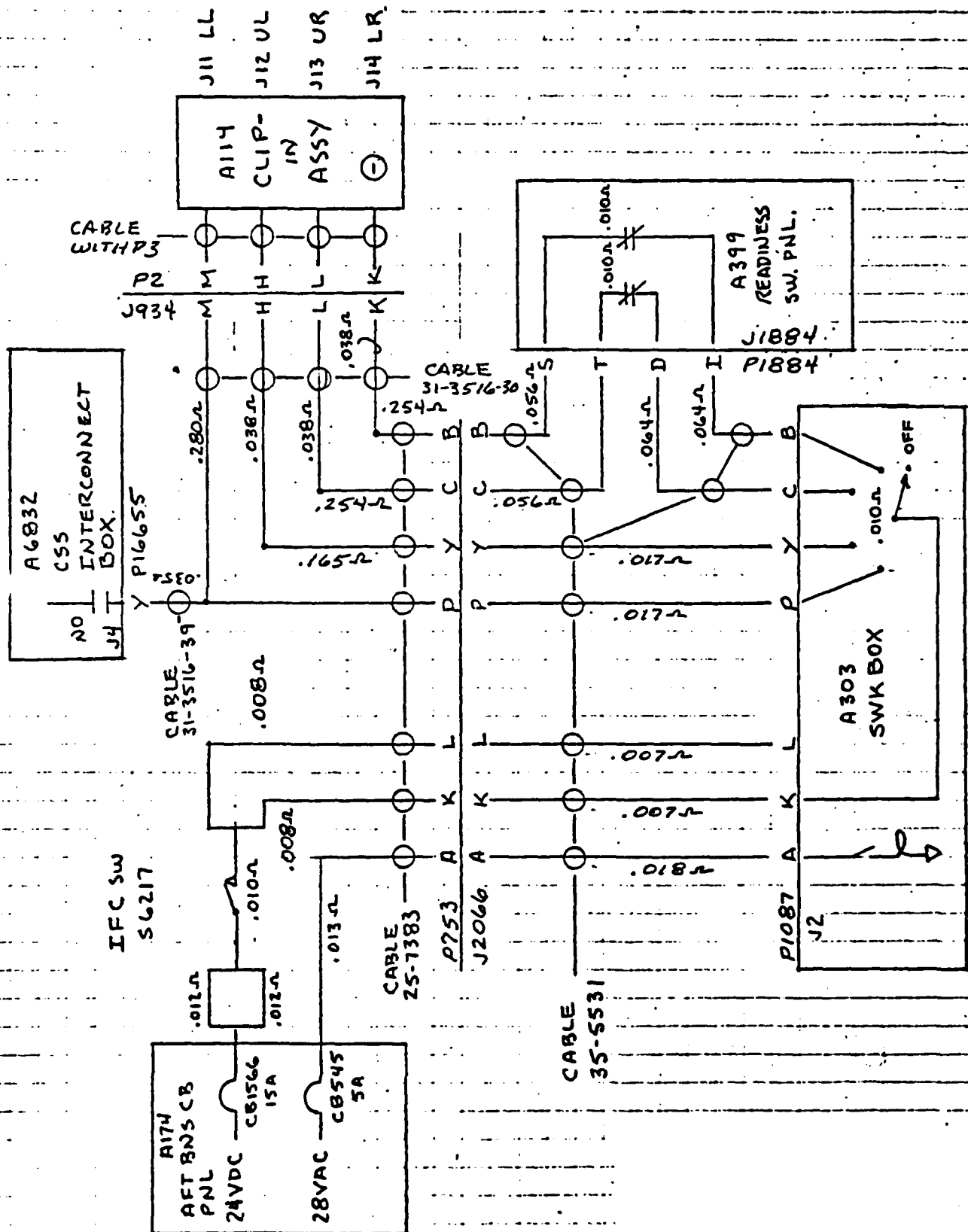| Analysis | Interface | Function |
|----------|-----------|----------|
| 4.1.7.1 | J1 Pin 97 | SAF Prearm Command |
| 4.1.7.2 | J1 Pin 82 | Missile Electronic Power |
|  | Pin 92 | Missile Electronic Power |
|  | Pin 96 | Missile Electronic Power |
| 4.1.7.3 | J1 Pin 57 | Propulsion Safe (Launcher) |
| 4.1.7.4 | J1 Pin 2 | Battery Activate |
|  | Pin 10 | Accumulator Activate |
|  | Pin 26 | Fin Unlock |
| 4.1.7.5 | J1 Pin 57 | Propulsion Safe (Pylon) |
| 4.1.7.6 | J1 Pin 82 | Missile Electronic Power (Pylon) |
|  | Pin 92 | Missile Electronic Power (Pylon) |
|  | Pin 96 | Missile Electronic Power (Pylon) |
| 4.1.7.7 | J1 Pin | (Ejector) Arm Solenoid |
| 4.1.7.8 | J1 Pin 20 | SAF Class III A Command |
|  | J Pin 60 | SAF Class III B Command |

NOTE:    Power Profiles - In all cases, short circuit current, caused by faults was found to be constant because of the absence of inductors and capacitors in the circuits investigated.  Voltage source impedance was assumed to be zero ohms.  A typical fault current versus time profile is shown here.
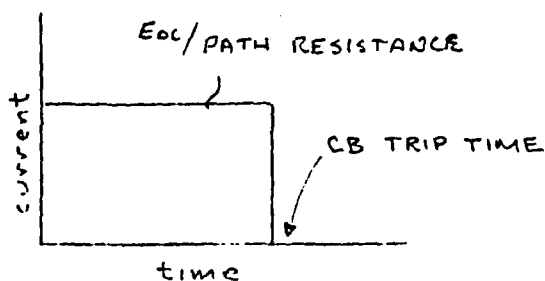


FAULT CURRENT PROFILE

4.1.7.1   Circuit Analysis Package, AGM 69A Interface Pin 97, Connector J1,
Missile #1 on the Launcher & Left Pylon

This interface is shown in Figure 5-7, T.O. 11L1-2-8-2, (Change 12) and T.O.
16W6-19-2 (Change 3).  Maximum current available to pin 97 in a normal environ-
ment is 0 amps.  Worst case current at 118VAC in an abnormal (faulted) environment
would be 900 amps for the missile on the launcher and 983 amps for the missile
on the pylon assuming the pins grounded.

P32
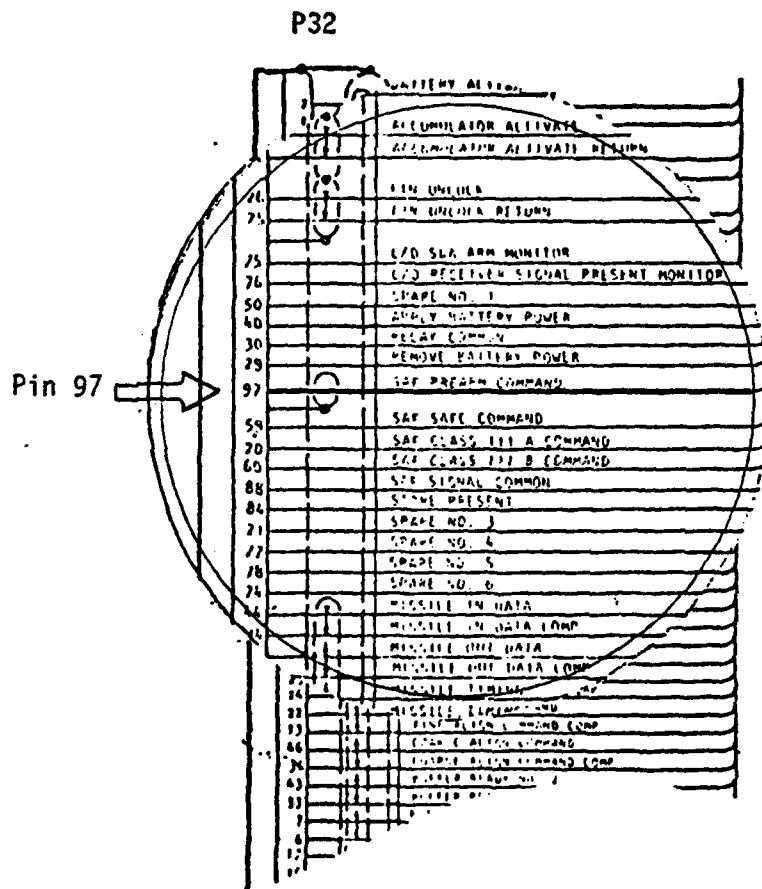


Pin 97

Refer to Figure 2-38
of T.O. 1B-52G-2-39GA-1
For Circuit Details

4.1.7.1    (Continued)

a.    <u>Normal Power & Load Analysis</u>

From an examination of Figure 4.1-52, Cable Drawing – showing applicable circuits in the MCU, open circuit voltage for pin 97 is 0 VDC (the electronic switch is off) and short circuit current is <u>0A</u>.

b.    <u>Fault Analysis</u>

The following postulated faults were analyzed using Network Tree 99B and 99C, and Figure 4.1-52, Cable Drawing.

Pin 97, J1 Missile #1 Launcher

①    <u>Cable W1 Damaged</u>

Wire to pin 97 shorted to 28VDC from CB1411, 118VAC from CB1395 if heater power is on, or to guidance and logic signals.

CB1411 (15A) 28VDC Missile Electronic Power

    Resistance of wire from CB to missile interface

        55 ft of #10 wire = .06 $\Omega$

        switch            = .01 $\Omega$

    Maximum current available = <u>400</u> A

CB1395 (15A) 118VAC Missile Heater Power

    Resistance of wire from CB to missile interface

        47 ft of #12 wire = .095 $\Omega$

        6 ft of #16 wire = .027 $\Omega$

        switch            = .01 $\Omega$

    Maximum current available = <u>900</u> A

Guidance and Logic Signals

Current output from these sources is device limited to less than other sources listed.

4.1.7.1   (Continued)

② <u>Launcher MCU Damaged</u>

Wire to pin 97 shorted to 27VDC from CB1484, $\pm$22VDC from power
supply in the switch unit, or guidance/logic signals.
CB1484 (5A) 27VDC Essential Power
    Resistance of wire from CB to MCU
        44 ft of #20 wire = .405 $\Omega$
    Maximum current available = <u>66</u> A
Power Supply in Switch Unit
    Current output is less than other source listed.  The magni-
    tude is unknown.  The specification is not available.

Guidance and Logic Signals
Current output from these sources is device limited to less than
other sources listed.

③ <u>Cable W13, W22 or W19 Damaged</u>

Wire to electronic switch shorted to 27VDC from CB1484 (Essential
Bus) or to guidance and logic signals in the same cable.  This
may cause the electronic switch to turn on supplying <u>300</u> mA at
27VDC to pin 97.

④ <u>Connector J16462/P1 or Cable 31-3564-119 Damaged</u>

Wire to electronic switch shorted to 27VDC from CB1484 (Essential
Bus) or to guidance and logic signals in the same cable.  This
may cause the electronic switch to turn on supplying <u>300</u> mA at
27VDC to pin 97.

Pin 97, J1 Missile #1 Left Pylon

⑤ <u>Cable W6 Damaged</u>

Wire to pin 97 shorted to 28VDC  from CB1444 (ELEX Bus), 118VAC
from CB1394 if heater power is 'on, or to guidance and logic signals.

4.1.7.1b  (Continued)

⑤  (Continued)

CB1444 (15A) 28VDC Missile Electronic Power

    Resistance of wire from CB to missile interface

        58 ft of #20 wire = .11 $\Omega$

        switch           = .01 $\Omega$

    Maximum current available = <u>233</u> A

CB1394 (10A) 118VAC Heater Power

    Resistance of wire from CB to missile interface

        58 ft of #12 wire = .11 $\Omega$

        switch           = .01 $\Omega$

    Maximum current available = <u>938</u> A

Guidance and Logic Signals

The current output of these sources is device limited to less
than other sources listed.

⑥  <u>*Left Pylon MCU Damaged*</u>

Wire to pin 97 shorted to 27VDC from CB1483 (Essential Bus),
± 22VDC from power supply in the switch unit, or to guidance and
logic signals.

CB1483 (5A) 27VDC Essential Power

    Resistance of wire from CB to MCU

        50 ft of #20 wire = .619 $\Omega$

    Maximum current available = <u>43.5</u> A

Power Supply in Switch Unit

    Current output is less than other listed source.  The magni-
    tude is unknown.  The specification is not available.

Guidance and Logic Signals

Current output from these sources is device limited to less than
other sources listed.

4.1.7.1b  (Continued)

⑦  Cable W1 Left Pylon, Connector J16460/P1, Cable 31-3564-114,
Connector P16539/J16539 or Cable 31-3564-117 Damaged

Wire to electronic switch shorted to 28VDC from CB1411, 27VDC
from CB1483 or guidance and logic signals in the same cable.
This may cause the switch to turn on supplying 300 mA at
27VDC to pin 97.

Pin 97, J1 Missile #1 Launcher or Left Pylon

⑧  PDU Damaged

Wire to electronic switch of both MCU's shorted to 118VAC from
CB1487 (AC Bus), 118VAC-3ϕ(AC Bus) from CB1422, 27VDC from CB1486,
or guidance and logic signals.  This may cause the switches to
to turn on supplying 300 mA at 27VDC to pin 97 of both missiles.

⑨  Cabling from PDU to Right Pylon MCU Damaged

Wire to electronic switch of both MCU's shorted to 27VDC from
CB1485 (Essential Bus) or guidance and logic signals.  This may
cause the switches to turn on supplying 300 mA at 27VDC to pin
97 of both missiles.

⑩  Right Pylon MCU Damaged

Wire to electronic switch of both MCU's shorted to 27VDC from
CB1485 (Essential Bus), +22VDC from Power Supply in the Switch
Unit, or guidance and logic signals.  This may cause the switches
to turn on supplying 300 mA at 27VDC to pin 97 of both missiles.

⑪  Cable 31-3564-52 Damaged

Wire to electronic switches in both MCU's are cabled with wires
running between the PDU and MDU/BCU.  These wires primarily carry
guidance, digital information and other low level signals.  A short
to them may cause the switches to turn on supplying 300 mA at
27VDC to pin 97 of both missiles.

4.1.7.1b  (Continued)

(12)  CSS Interconnect Box Damaged

Wires to electronic switch of both MCU's shorted to 24VDC from
CB1566.  This may cause the electronic switches to turn on
supplying 27VDC at 300 mA to both missiles.  The 24 VDC is avail-
able only when the SWK Box is switched to "LL".

Note:  All circuit breakers or located in the AGM-69A Power
Distribution Box, A482 except CB1566 which is located in the
Aft BNS CB PNL, A174.

c.  Worst Case Paths

Launcher Missile pin 97: Reference path(1) Cable W1 Damaged.
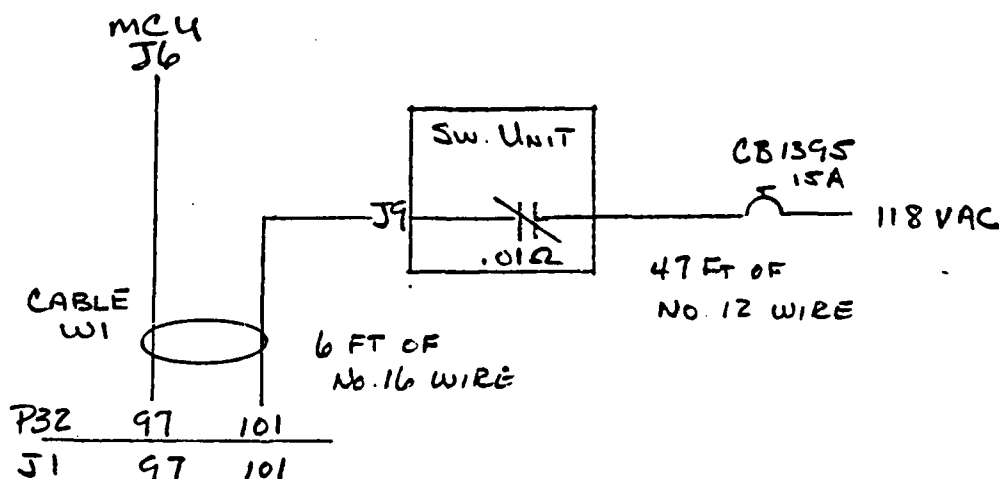


Total resistance of path = .122 $\Omega$

$V_{OC}$ = 118VAC

$I_{SC} = \dfrac{.118}{.122} = \underline{900}$ A

Time = current exceeds 6000% rating of CB.  The time will be less
than .13 sec (3000% rating).

4.1.7.1c (Continued)

Left Pylon Missile pin 97: Reference path⑤ Cable W6 Damaged.
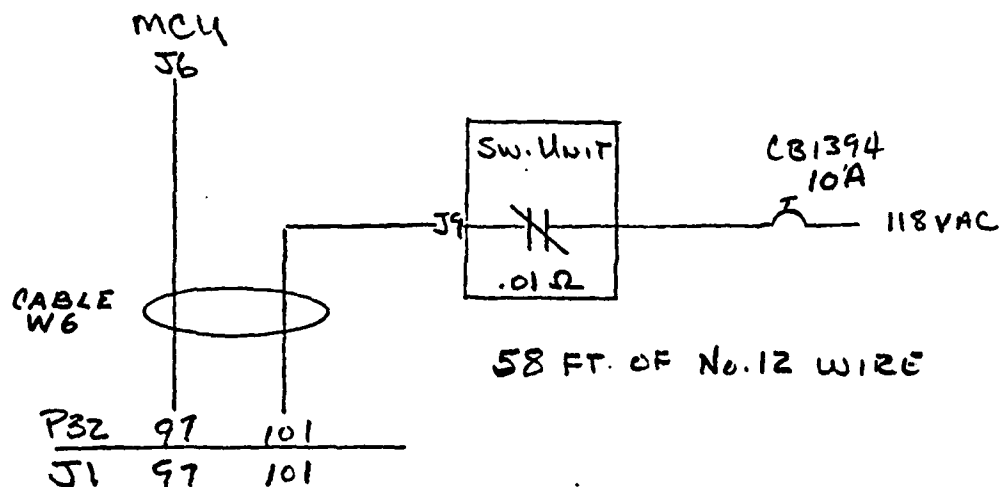


Total resistance of path = .12 $\Omega$

$V_{OC}$ = 118VAC

$I_{SC}$ = $\dfrac{118}{.12}$ = $\underline{983}$ A

Time = current exceeds 9000% rating of CB.  The time will be less than .125 Sec (3000% rating).  Reference CB Spec D10-30108.

# SNEAK CIRCUITS NETWORK TREE

REV

| PROJECT | | TITLE | | |
|---------|------|-------------------------|----------|-----------|
| B52G | | JETTISON RELEASE SYSTEM | | |
| QC | DATE | ANALYST | DATE | NODAL SET |
| | | | 4-25-75 | 99 B |

HOU-205

**BOEING** AEROSPACE COMPANY - HOUSTON, TEXAS

Figure 4.1-51  Network Tree No. 99B-99C  (Sheet 1 of 2)

Figure 4.1-51   Network Tree No. 99B-99C (Sheet 2 of 2)
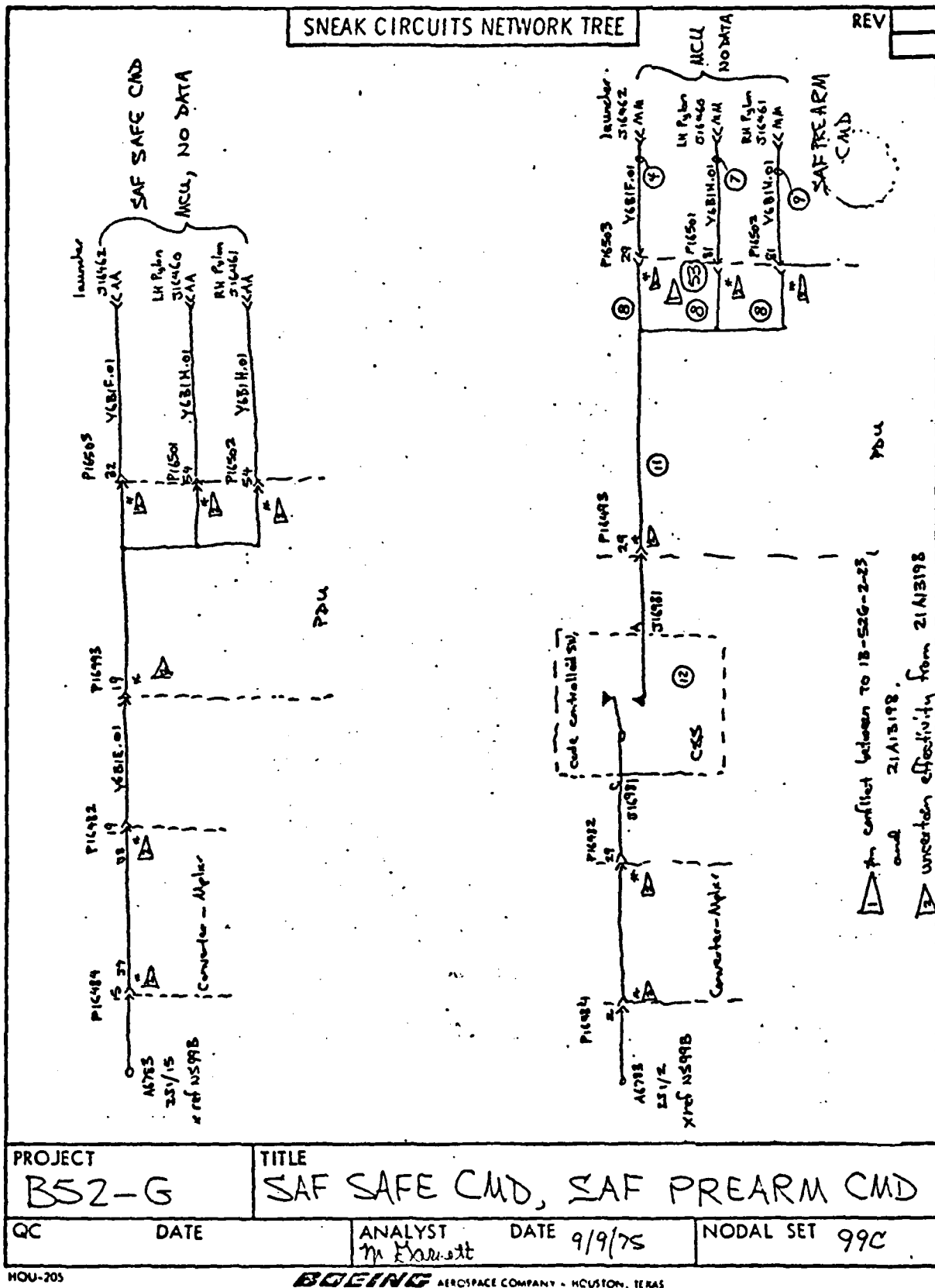
Notes:

Shorts to wires above MCU will cause switch in MCU to turn on applying normal power to missiles.

CSS ⑫
INTERCONNECT
BOX

J1
P16961

⊖ 31-3564-52 ⑪

P16493

J6    PDU
⑧

J8          J9          J11
P16501    P16502    P16503

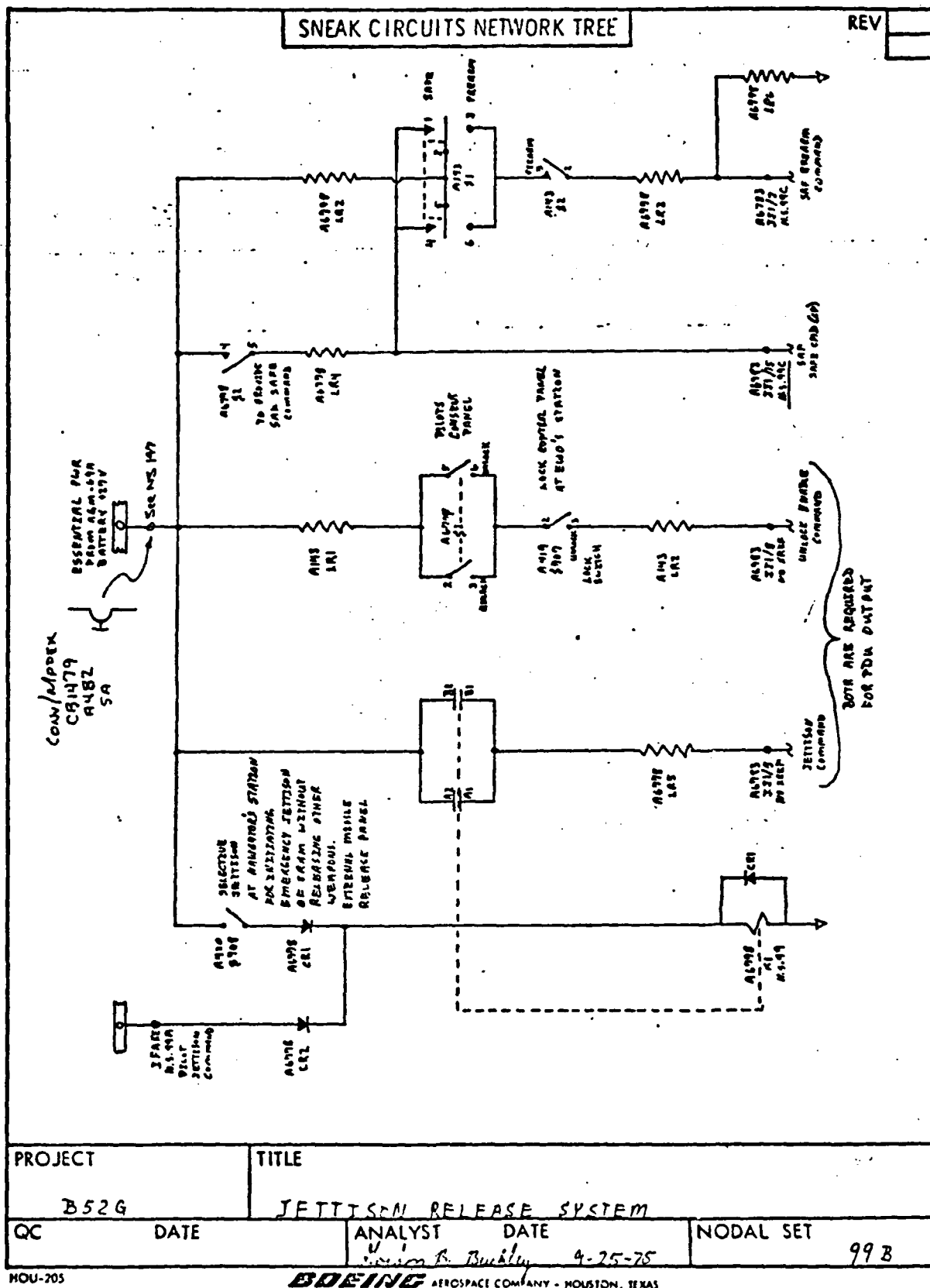31-3564-117 ⊖    -118 ⊖    -119 ⊖ ④

P16539      P16540    J16462
J16539      J16540    P1
⑦          ⑨

31-3564-114 ⊖    -113 ⊖ ⑨    ⊖ W19

J16460      J16461    P1
P1          P1

⊖ WIL    ⊖ WIR    ⊖ W22 ③

P4          P4        ⊖ W13

J4          J4        P-11
LEFT        RIGHT     J4      27V    MCU
PYLON ⑥    PYLON ⑩              ②    (TYPICAL OF
MCU         MCU                        EACH MCU)
                      LAUNCHER         J6
J6                              ELECTRONIC SWITCH
P24                                    P24

⑤                                    ①
⊖ W6                                  ⊖ WI

P32 97                                P32  97
J1  97                                J1   97

MISSILE #1 PYLON                      MISSILE #1 LAUNCHER

FIGURE 4.1-52.    CABLE DRAWING

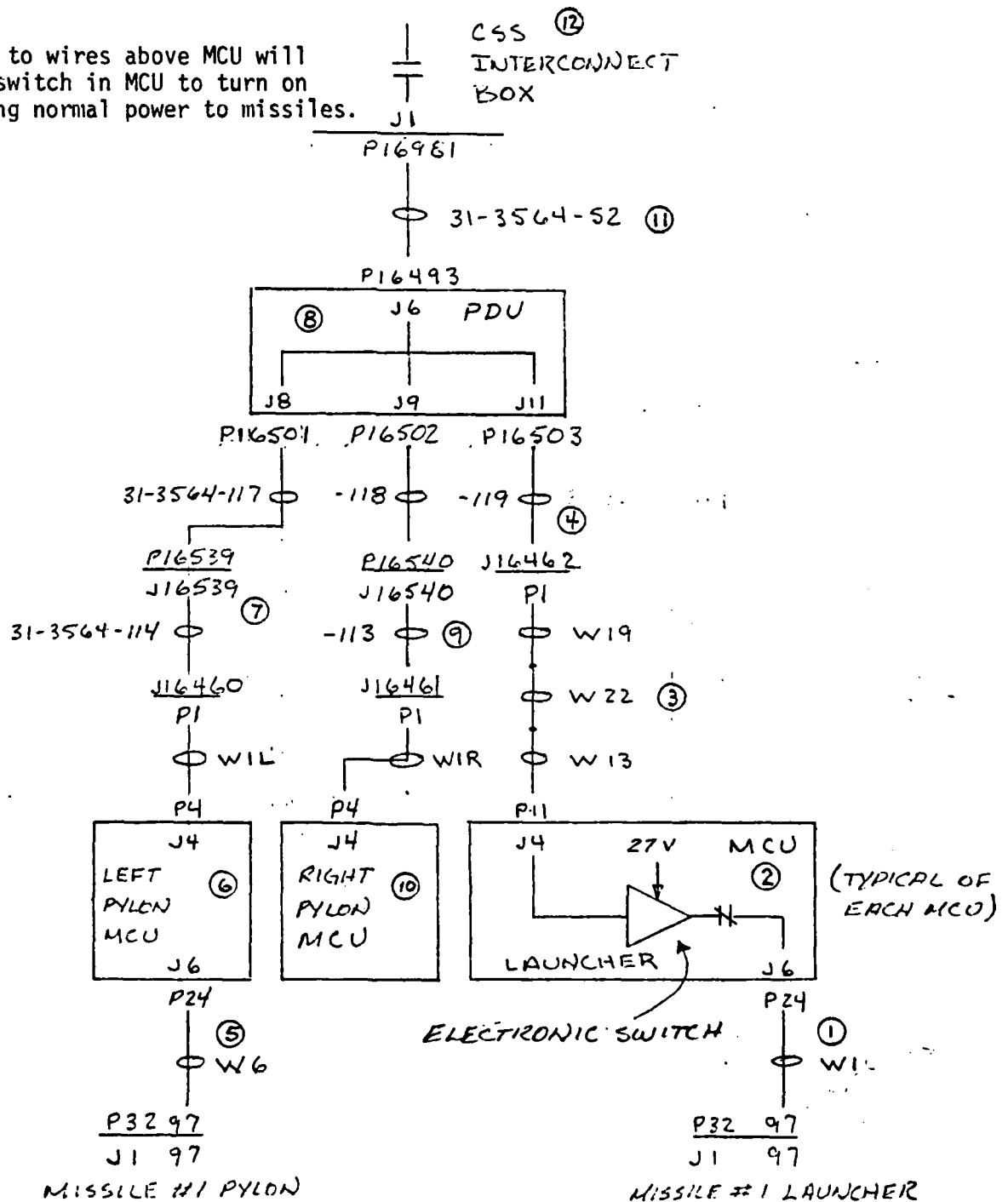**4.1.7.2** Circuit Analysis Package, AGM-69A Interface Pins 82, 92, and 96, Connector J1, Missile #1 on the Launcher

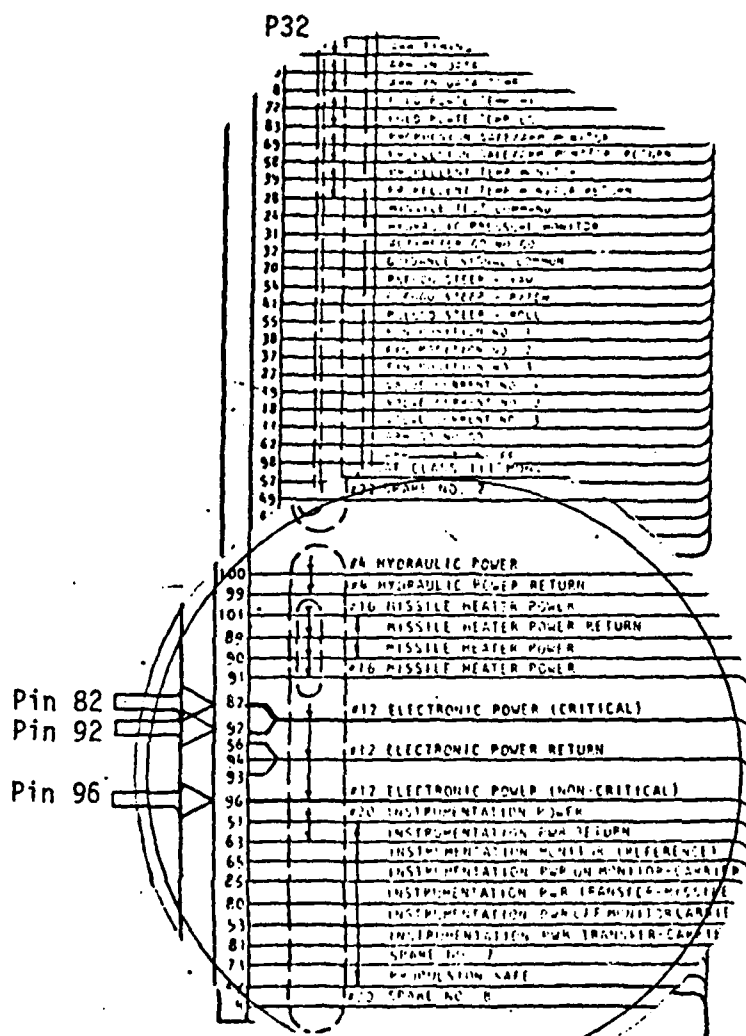This interface is shown in Figure 5-7 of T.O. 11L1-2-8-2, Change 12. Maximum current available to the pins in a normal environment with the pins grounded would be:

System Off:   Voc = 0V; Isc = 0 A

System On:   Voc = 28 VDC; Isc = _368_ A

Worst case current at 28VDC in an abnormal environment would be 1220 A with the pins grounded.



Refer to Figure 2-40 of T.O. 1B-52G-2-39GA-1 For Circuit Details

4.1.7.2    (Continued)

a.    <u>Normal Power and Load Analysis</u>

From examination of Figure 4.1-53, Network Tree 118 and Figure 4.1-54, Cable Drawing, open circuit voltage and short circuit voltage is as follows:

Ground, System Off:  $V_{oc} = 0V$; $I_{sc} = 0A$

Airborn, System On:  Current to pins is supplied by CB1411, 28VDC ELEX Bus, through 37 ft. of #10 wire ($.044\Omega$) and 17 ft. of #12 wire ($.0323\Omega$).  Total resistance of path = $.076\Omega$.

Therefore:

$V_{oc}$ = 28 VDC

$I_{sc} = \dfrac{28}{.026} = \underline{368}$ A

b.    <u>Fault Analysis</u>

The following postulated faults were analyzed using Figures 4.1.53 and 4.1.54:

①    <u>Cable WI Damaged</u>

Wires subject pins shorted to 118 VAC from CB 1395 if heater power is on.

CB1395 (15A) 118 VAC Missile Heater Power

Resistance of wire from CB to missile interface

47 ft. of #12 wire = $.095\Omega$

6 ft. of #16 wire = $.027\Omega$

Maximum current available at 118 VAC = $\underline{967}$ A

②    <u>Switch Unit Damaged</u>

Wires to subject pins shorted to:

118 VAC from CB 1395, Heater Power

28 VDC from CB 1433, Hydraulic Power

28 VDC from CB 1412 through CB 1418, Missile 2-8 ELEX Power

118 VAC from CB 1427, Launcher AC

28 VDC from CB 1435, Missile Valve

4.1.7.2b  (Fault 2 Continued)

CB 1395 (15A) 118 VAC Missile Heater Power

Resistance of wire from CB to switch unit

47 ft. of #12 wire = .095Ω

Maximum current available at 118 VAC = <u>1242</u> A

CB 1433 (60A) 28 VDC Hydraulic Power

Resistance of wire from CB to Switch Unit

48 ft. of #4 wire = .013Ω

Maximum current available at 28 VDC = <u>2154</u> A

CB 1412 - CB 1418 (15A) 28 VDC Missile ELEX Power

Resistance of wire from CB's to Switch Unit

37 ft. of #10 wire = .044Ω

10 ft. of #12 wire = .019Ω

Maximum current available at 28 VDC = <u>444</u> A

CB 1427 (5A) 118 VAC Launcher AC·

Resistance of wire from CB to Switch Unit

37 ft. of #20 wire = .34Ω

10 ft. of #16 wire = .045Ω

Maximum current available at 118 VAC = <u>306</u> A

CB 1435 (7.5A) 28 VDC Missile Valve

Resistance of wire from CB to Switch Unit

47 ft. of #16 wire = .21Ω

Maximum current available at 28 VDC = <u>133</u> A

③  <u>Cable W10 Damaged</u>

Same faults as given in ② above omitting power from CB 1395, CB 1417, CB 1418, and CB 1433.

④  <u>Cable W23 or W17</u>

Same faults as given in ② above.

4.1.7.2b  (Fault 5 Continued)

(5)   Cable 31-3564-124 or Connector P2/J2371 Damaged

Wires to subject pins shorted to:

    118 VAC from CB 1395, Heater Power

    28 VDC from CB's 1412 through CB 1417, Missile 2-7, ELEX Power

    118 VAC from CB 1427, Launcher AC

    28 VDC from CB 1435, Missile valve

    CB 1395 (15A) 118 VAC Missile Heater Power

        Resistance of wire from CB to connector

            37 ft. #12 wire = .07$\Omega$

        Maximum current available at 118 VAC = 1685 A

    CB 1412 - CB 1417, (15A) 28 VDC, Missile 2-7 ELEX Power

        Resistance of wire from CB to connector

            37 ft. #10 wire = .044$\Omega$

        Maximum current available at 28 VDC = 636 A

    CB 1427 (5A) 118 VAC Launcher AC

        Resistance of wire from CB to connector

            37 ft. #20 wire = .34$\Omega$

        Maximum current available at 118 VAC = 347 A

    CB 1435 (7.5A) 28 VDC Missile Valve

        Resistance of wire from CB to Switch Unit

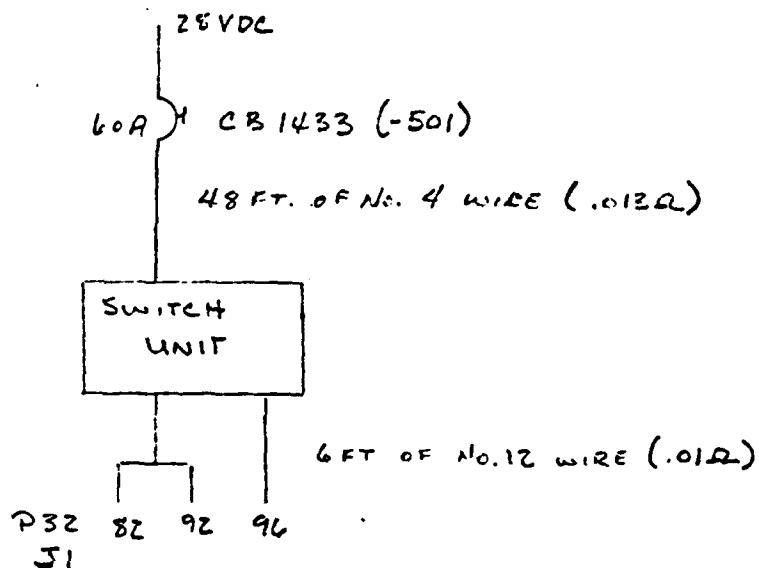            37 ft. of #16 wire = .166$\Omega$

        Maximum current available at 28 VDC = 168 A

Note:  All circuit breakers are located in the AGM-69A Power Distribution Box.
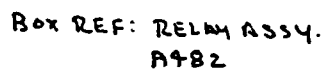
4.1.7.2b  (Fault 5 Continued)

c.    Worst Case Path

Reference Path ②  Switch Unit Damaged



Total Resistance of path = .023Ω

Voc = 28 VDC

$Isc = \frac{28}{.023} = \underline{1220}$ A

Time = Minimum trip time shown on calibration curve  is 1.5 seconds for
          500 amps.  Therefore the time for 1220 would be less than 1.5 seconds.

## SNEAK CIRCUITS NETWORK TREE

REV

NS224
B1411

NS118

CB1411
LAUNCHER
MSL 1 D.C.
PWR

③ ④ ⑤
NS176

SIA
127
NS176

A1    B1    Q2
SK1

A2    B2  ②

①

Q1

MSL PWR OFF
J10-58

MSL 1 PWR ON
J10-B

NS 363

K1, RESET
NS176

*

K1, SET
NS176

⭘ FAULTS

J9M    J1-82  J1-92  J1-96    MCU

LAUNCHER
MSL 1 PWR
ON INDKATOR

LAUNCHER
MSL 1
PWR

BOX REF: RELAY ASSY.
A482

NOTES: * RESISTANCE VALUES NOT SHOWN
ON DRAWINGS

Q2; 2N4399
VCEO = -60V MIN
Ic = -7.5A CONT

SK1; 10A @ 28VDC RES.
6A @ 28VDC IND.

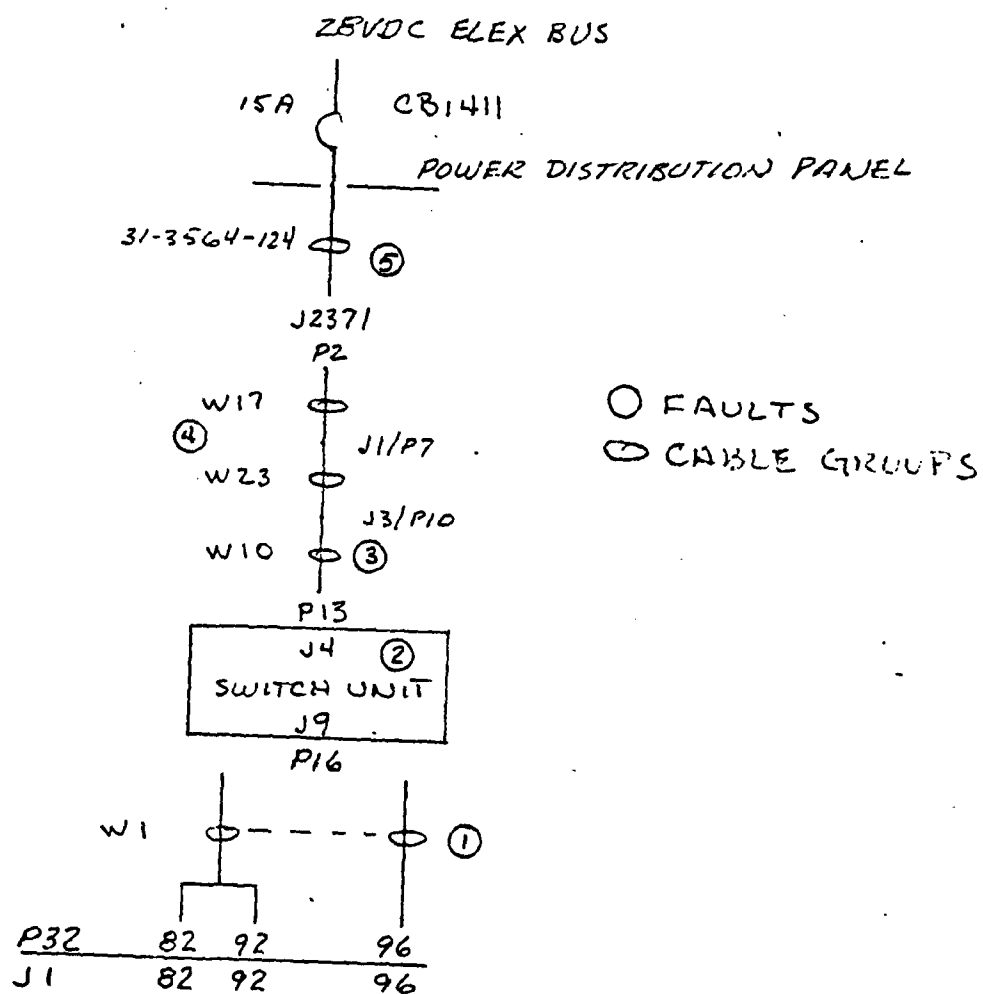| PROJECT | TITLE | | |
|---|---|---|---|
| B52-G | MISSILE #1 DC. POWER - LAUNCHER | | |
| QC          DATE | ANALYST    DATE | | NODAL SET |
| | J.D.e.    9 SEPT 1975 | | 118, 176, 363 |

Figure 4.1-53  Network Tree No. 118

FIGURE 4.1-54. CABLE DRAWING

4.1.7.3    Circuit Analysis Package, SRAM, Interface Pin 57 of Connector J1,
Missile 1 on the Launcher

This interface is shown in Figure 5-7, of T.O. 11L1-2-8-2, change 12.
The current available to this pin in a normal environment is 0 amps.  The
worst-case current in an abnormal environment (faulted) is <u>411.76</u> A
(assuming the pin is grounded).
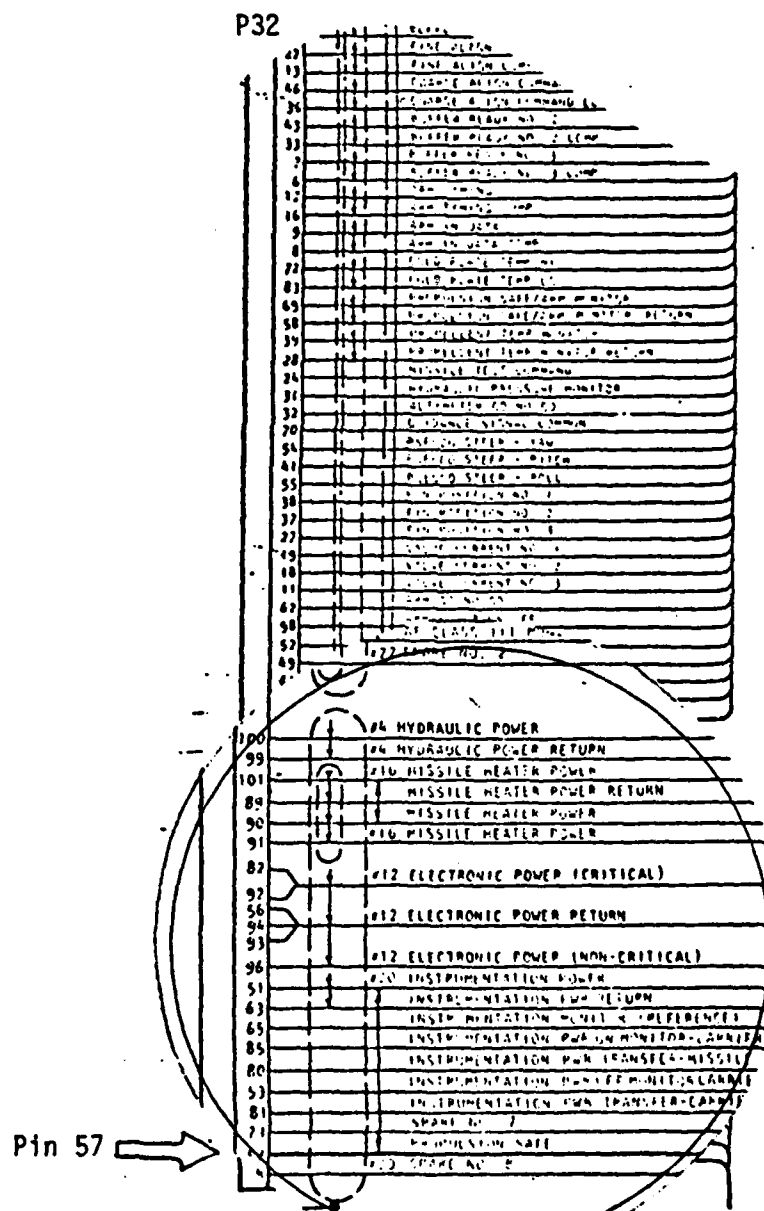


Refer to Figure 2-38 of
T.O. 1B-52G-2-39GA-1 For
Circuit Details.

4.1.7.3   (Continued)

a.   Normal Power and Load Analysis

From an examination of the Figure 4.1-55, Network Tree 151, the open circuit voltage is 0V and the short circuit current is 0A.  The circuit passes through normally open relay contacts in the Power Distribution Panel.

b.   Fault Analysis

The following postulated faults were analyzed using Network Tree 151 and the Cable Diagram, Figures 4.1-55 and 4.1-56.

(1)   Damage to Connector J1 or Cable W1

Pin 57 may be shorted to 118 VAC through CB 1395, if heater power is on, or to 28 VDC through CB 1411.

CB 1395 (15A) 118 VAC Missile Heater Power
   Resistance of wire from CB to missile
      47 ft. of #12 wire = .095$\Omega$
      6 ft. of #16 wire = .027$\Omega$
   Maximum current available at 118 VAC = 967 A

CB 1411 (15A) 28 VDC Missile Electronic Power
   Resistance of wire from CB to missile
      37 ft. of #10 wire = .044$\Omega$
      17 ft. of #12 wire = .0323$\Omega$
   Maximum current available at 28 VDC = 3680 A

(2)   Damage to Relay Assembly

The wires to the subject pins may be shorted to 28 VDC through CB 1433, CB 1435,  CB 1411-CB 1418 or shorted to 118 VAC through CB 1395 or CB 1427.

CB 1433 (60A) 28 VDC Hydraulic Power
   Resistance of wire from CB to Relay Assembly
      48 ft. of #4 wire = .013$\Omega$
   Maximum current available at 28 VDC = 2154 A

4.1.7.3b  (Fault 2 Continued)

CB 1435 (7.5A) 28 VDC Missile Bypass Valve

Resistance of wire from CB to Relay Assembly

47 ft. of #16 wire = .21Ω

Maximum current available at 28 VDC = <u>133</u> A

CB 1411 -CB 1418 (15A) 28 VDC Missile Electronic Power

Resistance of wire from CB's to Relay Assembly

37 ft. of #10 wire = .044Ω

10 ft. of #12 wire = .019Ω

Maximum current available at 28 VDC = <u>444</u> A

CB 1395 (15A) 118 VAC Missile Heater Power

Resistance of wire from CB to Relay Assembly

47 ft. of #12 wire = .095Ω

Maximum current available at 118 VAC = <u>1242</u> A

CB 1427 (5A) 118 VAC Launcher AC ·

Resistance of wire from CB to Relay Assembly

37 ft. of #20 wire = .34Ω

10 ft. of #16 wire = .045Ω

Maximum current available at 118 VAC = <u>306</u> A

(3)  <u>Cable W10 Damaged</u>

Faults are the same as (2) except power from CB 1395, CB 1417, CB 1418, and CB 1433 is not available.

(4)  <u>Cable W23 or Cable W17 Damaged</u>

Faults same as (3) above.

4.1.7.3b  (Fault 5 Continued)

⑤    Cable 31-3564-124 or Connector J2371 Damaged

Wires to subject pins may be shorted to 28 VDC through CB 1411-
CB 1418 or through CB 1435.  Wires may be shorted to 118 VAC
through CB 1395 or CB 1427.

    CB 1411 - CB 1418 (15A) 28 VDC Missile Electronic Power
        Resistance of wire from CB to Connector
            37 ft. of #12 wire = .07Ω
        Maximum current available at 28 VDC = <u>1685</u> A
    CB 1435 (7.5A) 28 VDC Missile Bypass Valve
        Resistance of wire from CB to Connector
            37 ft. of #16 wire = .166Ω
        Maximum current available at 28 VDC = <u>168</u> A
    CB 1395 (15A) 118 VAC Missile Heater Power
        Resistance of wire from CB to Connector
            37 ft. of #12 wire = .07Ω
        Maximum current available at 118 VAC = <u>1685</u> A
    CB 1427 (5A) 118 VAC Launcher AC Power
        Resistance of wire from CB to Connector
            37 ft. of #20 wire = .34Ω
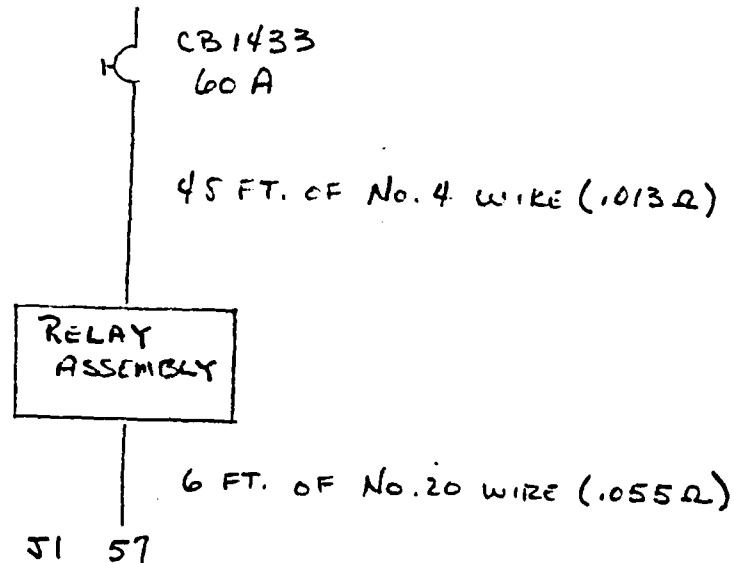        Maximum current available at 118 VAC = <u>347</u> A


    Note:  All circuit breakers are located in the AGM-69A
           Power Distribution Box.

4.1.7.3    (Continued)

c.    <u>Worst Case Path</u>

Refer to Fault ②, Relay Assembly Damaged



Total Resistance of path = .068Ω

Voc = 28 VDC

Isc = $\frac{28}{.068}$ = <u>411.76</u> A

Time = 2.0 seconds

FIGURE 4.1-55. NETWORK TREE 151

4-102

CB6047
10 AMP

1482 AGM-69A
Power Distribution
Box

51-3564-124

⑤ .0452Ω  38' of #10

H — — J2371

W17

K — J1

④

W23

10' of #16
.0452Ω

J3

F

③ W10

K J4

② RELAY
ASSEMBLY

J7

W1,
6' of #20
.0551Ω
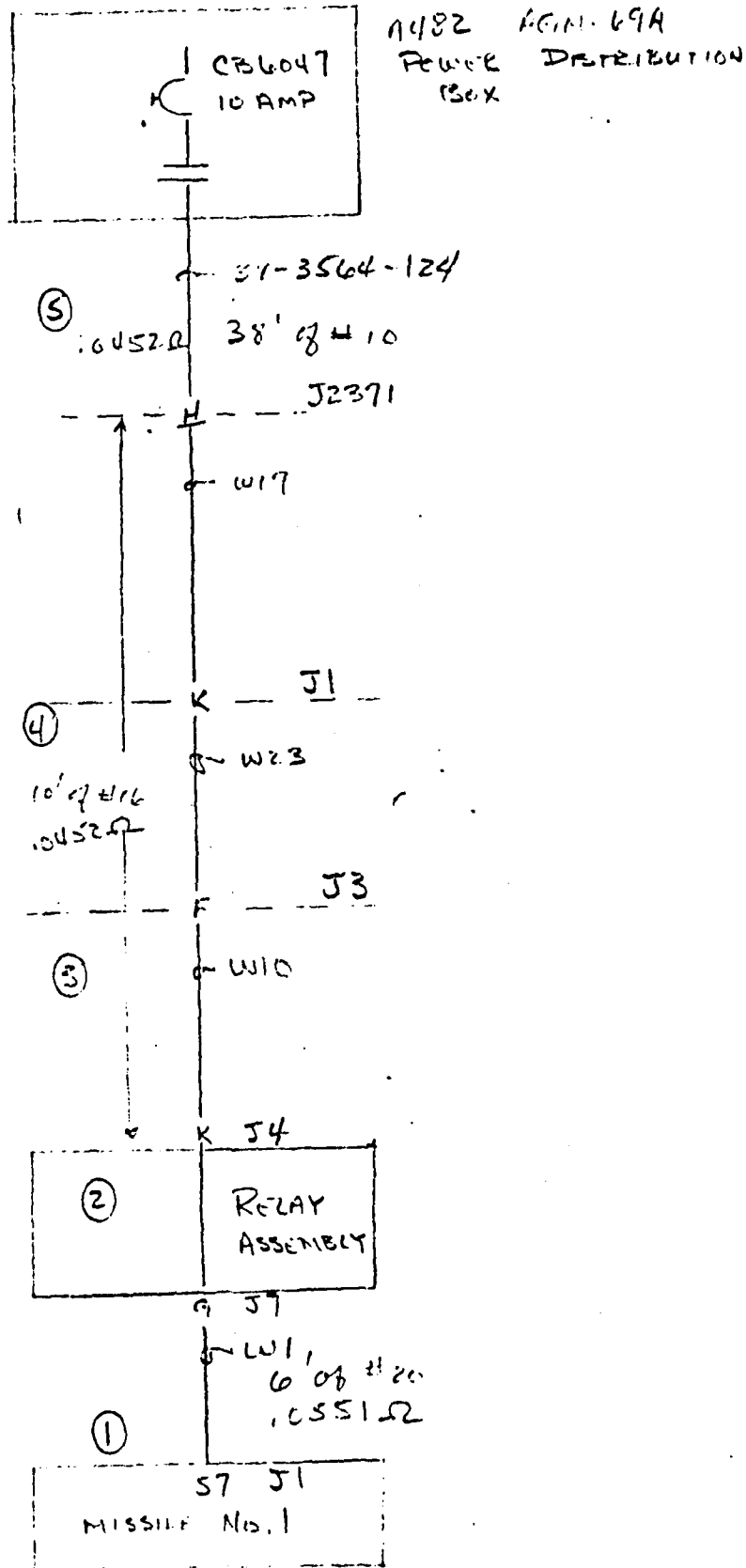
①

S7 J1

MISSILE NO. 1

FIGURE 4.1-56.  CABLE DRAWING

6-103

4.1.7.4    Circuit Analysis Package, AGM 69A Interface Pins 10, 26, and 2,
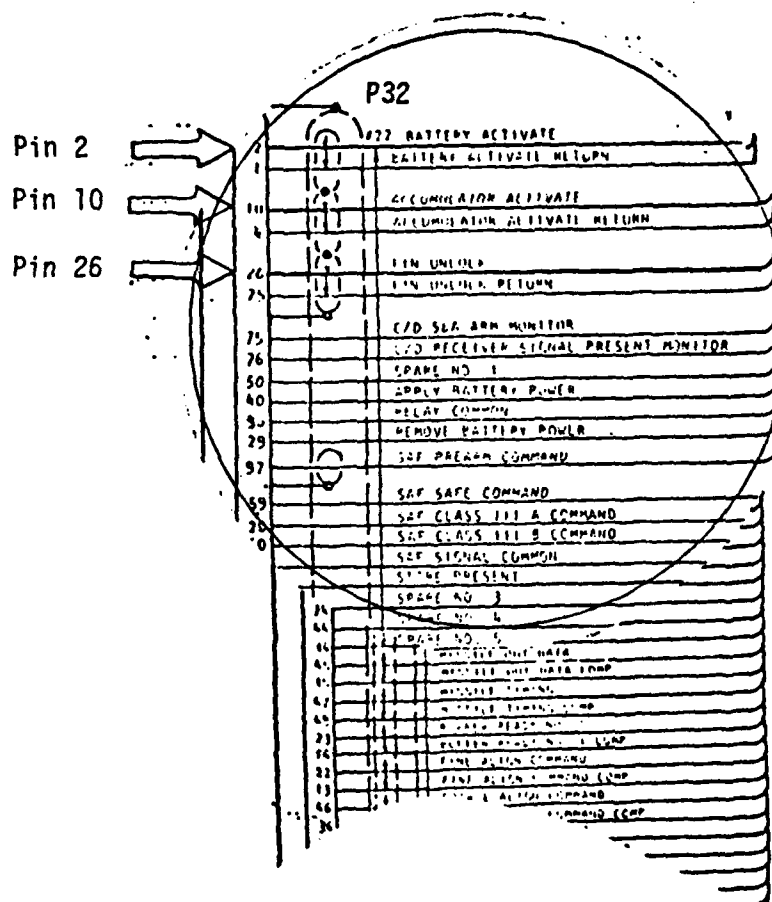Connector J1, Missile #1 on the Launcher and Left Pylon

This interface is shown in Figure 5-7  of T.O. 11L1-2-8-2, Change 12.
Maximum current available to these pins in a normal environment is 0 amps.
Worst case current at 118 VAC in an abnormal (faulted) environment with
the pins grounded would be:

Launcher Missile   900 A
Pylon Missile      983 A



Refer to Figure 2-39 of
T.O. 1B-52G-2-39GA-1 For
Circuit Details.

4.1.7.4   (Continued)

a.   Normal Power and Load Analysis

From an examination of Figure 4.1-58, Cable Drawing, open circuit voltage
is 0V and the short circuit current is 0A.  The electronic switches and
EED power are normally off prior to launch.

b.   Fault Analysis

The following postulated faults were analyzed using Network Tree 144-145
for Launcher Mounted Missile and Figure 4.1-58.

(1)   Cable W1 Damaged

Wires to pins 10, 2 and 26 shorted to 28 VDC from CB 1411, to
118VAC from CB1395 (if heater power is on) or to guidance and
logic signals.

CB 1411 (15A) 28 VDC Missile Electronic Power
   Resistance of wire from CB to missile interface
      55 ft. of #10 wire = .06Ω
      Switch                = .01Ω
   Maximum current available = 400 A
CB 1395 (15A) 118 VAC Missile Heater Power
   Resistance of wire from CB to missile interface
      47 ft. of #12 wire = .095Ω
       6 ft. of #16 wire = .027Ω
   Maximum current available = 940 A
Guidance and Logic Signals
   Current from these sources is device limited and is less
   than other sources listed.

4.1.7.4b  (Continued)

(2)  Launcher MCU Damaged

Wire to pins 10, 2 and 26 shorted to 27 VDC from CB 1484, ± 22VDC
from Power Supply in the Switch Unit, or to guidance and logic
signals.

    CB 1484 (5A) 27 VDC Essential Power

        Resistance of wire from CB to MCU

           44 ft. of #20 wire = .405$\Omega$

        Maximum current available = 66 A

    Power Supply in Switch Unit

        Current output less than other source listed.  The magnitude
        of the current is unknown since the part specification is
        not available.

    Guidance and Logic Signals

        Current output is device limited and is less than
        other sources listed.

For Pylon Mounted Missile

(1)  Cable W6 Damaged

Wires to pins 10, 2 and 26 shorted to 28 VDC from CB 1444, 118VAC
from CB1394, if heater power is on, or to guidance and logic
signals.

    CB 1444 (15A) 28 VDC Missile Electronic Power

        Resistance of wire from CB to missile interface

           58 ft of #20 wire = .11$\Omega$

           Switch         = .01$\Omega$

        Maximum current available = 233 A

    CB 1394 (10A) 118 VAC Heater Power

        Resistance of wire from CB to missile interface

           58 ft. of #12 wire = .11$\Omega$

           Switch         = .01$\Omega$

        Maximum current available = 983 A

    Guidance and Logic Signals

        Current output from these sources is device limited and
        is less than other sources listed.

4.1.7.4b  (Continued)

   ②   Left Pylon MCU Damaged

Wires to pins 10, 2 and 26 shorted to 27 VDC from CB 1483, $\pm$ 22VDC from power supply in Switch Unit or guidance and logic signals.

   CB 1483 (5A) 27 VDC Essential Power

      Resistance of wire from CB to MCU

         50 ft. of #20 wire = .619Ω

      Maximum current available = <u>43.5</u> A

   Power Supply in Switch Unit

      Current output is less than other listed source.  The magnitude is unknown since the specification is unavailable.
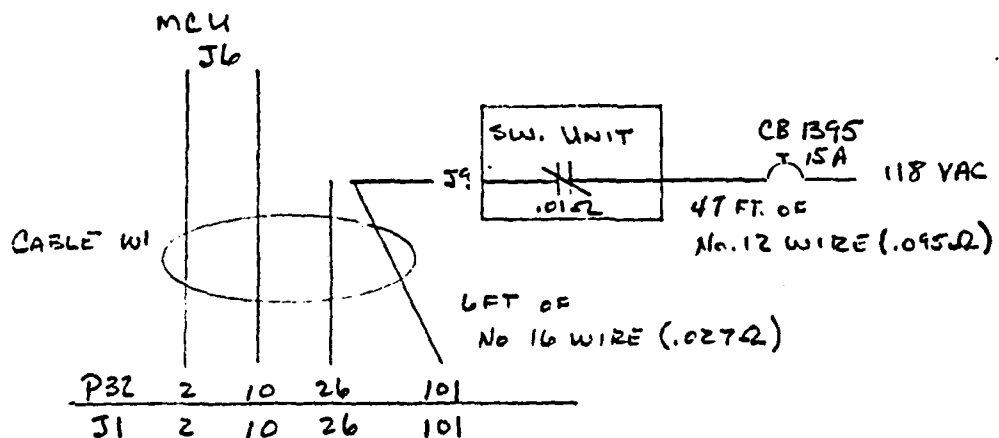
   Guidance and Logic Signals

      Current output from these sources is device limited and is less than other sources listed.

Note:  Circuit Breakers are located in the AGM-69A Power Distribution Panel.

c.  Worst Case Paths

   For Launcher Mounted Missile

      Reference Path ① Cable W1 Damaged
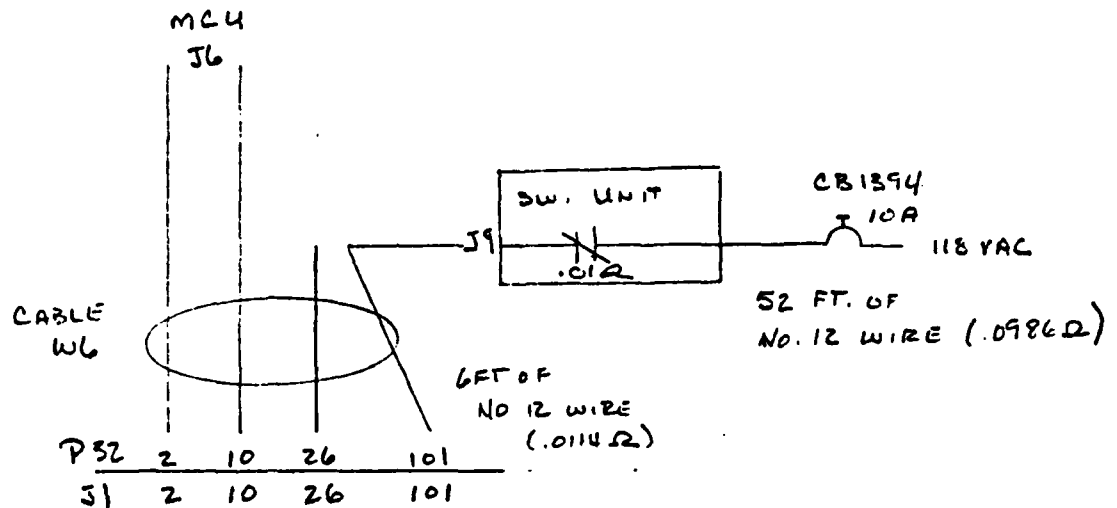


Total Resistance of Path = .122Ω

Voc = 118 VAC

Isc = $\dfrac{118}{.122}$ = <u>900</u> A

Time – Current rating exceeds 6000% rating of CB.  The time will be less than .13 sec. (3000% rated).

4.1.7.4c  (Continued)

For Pylon Mounted Missile
    Reference Path (1) Cable W6 Damaged



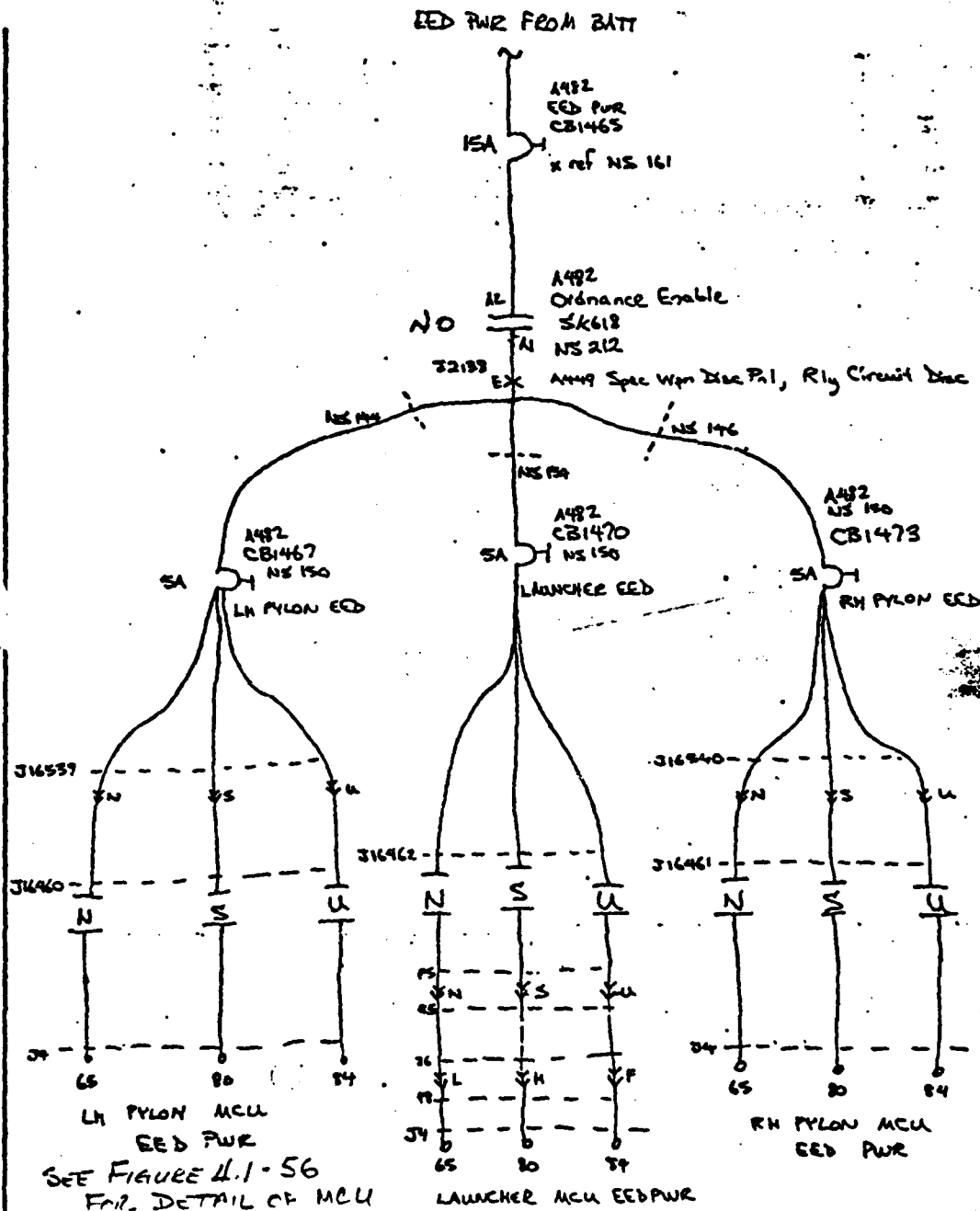58 ft. of #12 wire total

Total resistance .12Ω

$Voc = 118\ VAC$

$Isc = \dfrac{118}{.12} = \underline{983}\ A$

Time - Current exceeds 9000% rating of CB.  The time will be less than
        .125 sec. (3000% rated), Reference CB Spec. D10-30108.

SNEAK CIRCUITS NETWORK TREE

REV

EED PWR FROM BATT

A482
EED PWR
CB1465
15A
x ref NS 161

A482
Ordnance Enable
NO          SK618
NS 212

3213?   EX    A449 Spec Wpn Disc Pal, Rly Circuit Disc

NS 144                              NS 146

NS 134

A482
A482                        CB1470          A482
CB1467                      NS 150          NS 150
NS 150                                       CB1473
5A                5A                      5A
LH PYLON EED   LAUNCHER EED              RH PYLON EED

J16539                                              J16540
  N      S      U                              N      S      U

J16460                    J16462            J16461
  N      S      U      N      S      U        N      S      U

N      S      U                              N      S      U

                          N      S      U

                          L      H      F

65     80     84      J4                     65     80     84
                        65     80     84
LH PYLON  MCU                              RH PYLON MCU
  EED PWR                                   EED PWR
SEE FIGURE 4.1-56
FOR DETAIL OF MCU    LAUNCHER MCU EEDPWR

| PROJECT | TITLE | | |
|---------|-------|---|---|
| B52-G | EED PWR | | |
| QC 24 | DATE 9-15-75 | ANALYST M. Brnett  DATE 9.18/75 | NODAL SET 144, 145, 146, 150 |

Figure 4.1-57   Network Tree No. 144-145

NOTE:  CABLING AND CONNECTORS ARE
       SHOWN FOR MISSILE MOUNTED
       IN THE LAUNCHER.  FOR MISSILE
       MOUNTED ON THE LEFT PYLON:

       W1   IS W6
       P24  IS P15
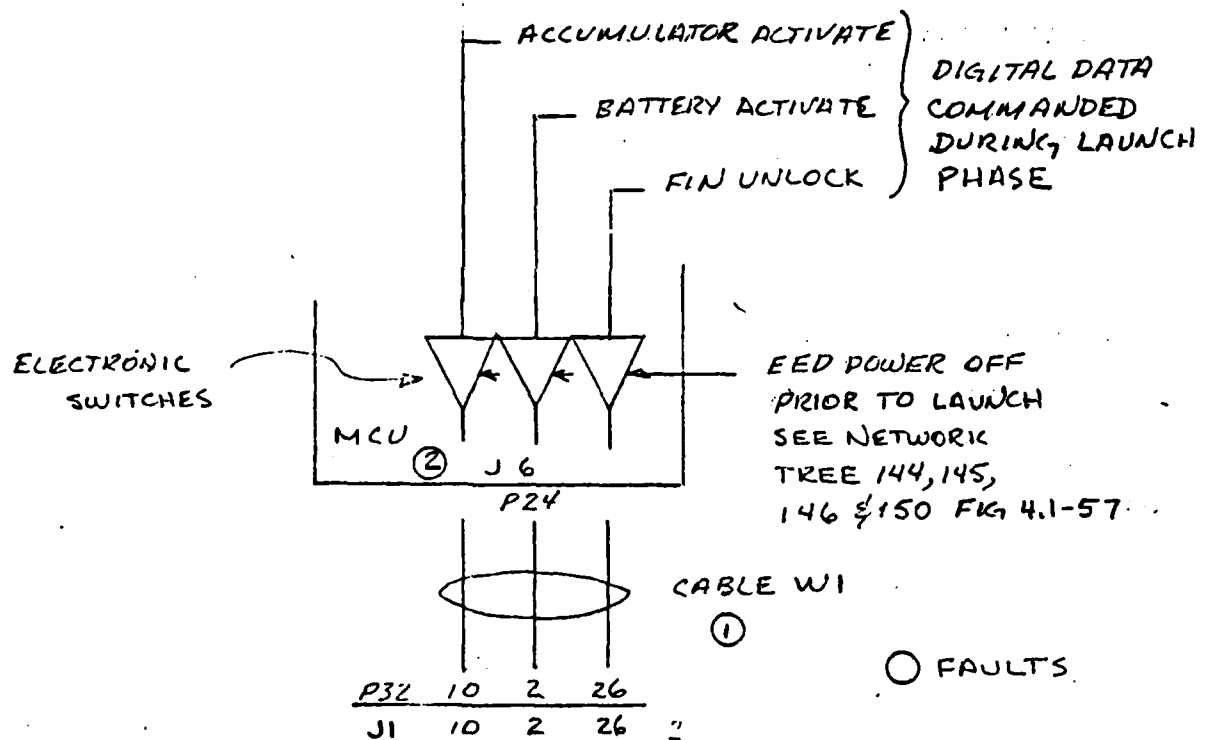       P32  IS P32
       J1   IS J1



FIGURE 4.1-58.   CABLE DRAWING

4.1.7.5   Circuit Analysis Package, SRAM, Interface Pin 57 of Connector
          J1, Missile 1 on the Left Pylon

This interface is shown in Figure 5-7 in  T.O. 16W6-19-2, Change 3.  The
current available to this pin in a normal environment is 0 A.  The worst
case current in an abnormal environment (faulted) is 1115.5 A, assuming
the pin is grounded.



Pin 57
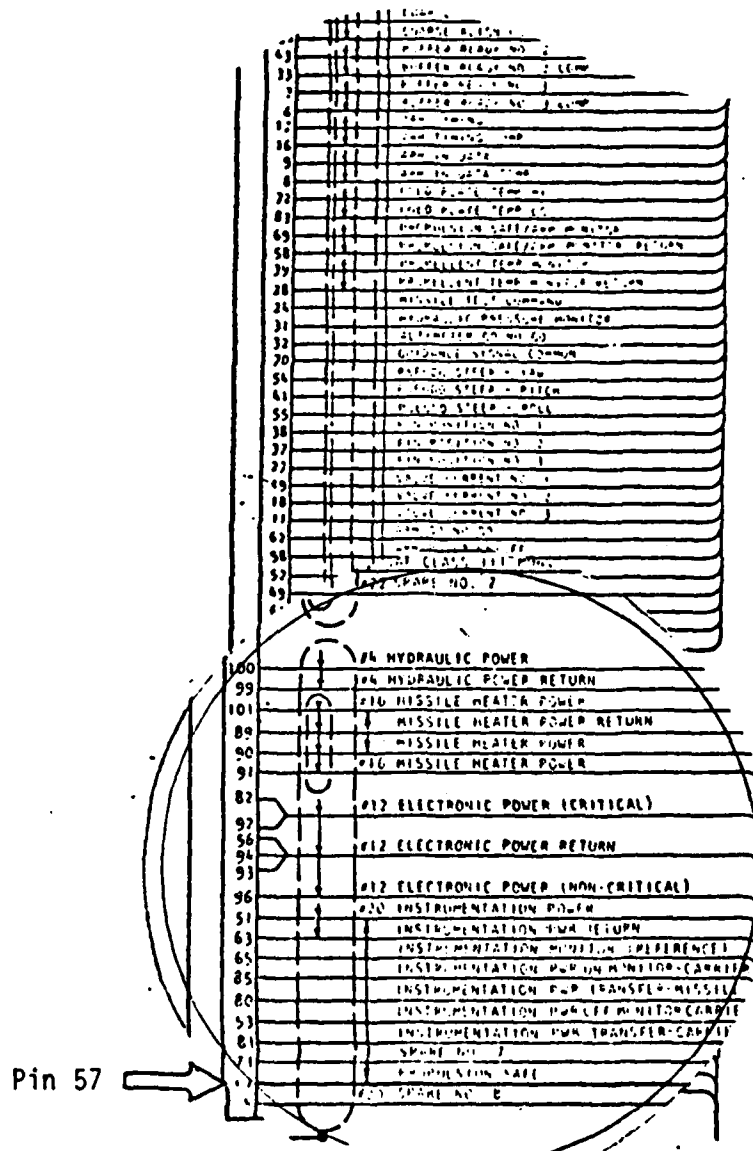
Refer to Figure 2-38 of
T.O. 1B-52G-2-39GA-1 For
Circuit Details

4.1.7.5   (Continued)

a.   Normal Power and Load Analysis

From an examination of Figure 4.1-59, Sneak Circuit Network Tree 153, the normal open circuit voltage is OV and the short circuit current is OA.   The circuit passes through normally open relay contacts in the Power Distribution Panel.

b.   Fault Analysis

The following postulated faults were analyzed using Figure 4.1-59, Network Tree 153 and Figure 4.1-60, Cable Drawing.

①   Damage to Connector J1 or Cable W6

Pin 57 may be shorted to 28 VDC through CB 1444 or to 118 VAC through CB 1394.

CB 1444 (15A) 28 VDC Missile Electronic Power

Resistance of wire from CB to missile interface

58 ft. of #12 wire = .1102$\Omega$

Relay Contact Resistance = .01$\Omega$

Maximum current available at 28 VDC = 232 A

CB 1394 (10A) 118 VAC Missile Heater Power

Resistance of wire from CB to missile

58 ft. of #12 wire = .1102$\Omega$

Relay contact resistance = .01$\Omega$

Maximum current available at 118 VAC = 981.7 A

4.1.7.5b (Continued)

②   <u>Damage to the Relay Assembly or Cable W2</u>

Wires to the subject pin may be shorted to 28 VDC through CB 1450, CB 1444, CB 1434, or shorted to 118 VAC through CB 1401 or CB 1394.

    CB 1450 (7.5A) 28 VDC Bypass Valve Power

       Resistance of wire from CB to Relay Assembly

          52 ft. of #12 wire = .0988 $\Omega$

       Maximum current available at 28 VDC = <u>283.4</u> A

    CB 1444 (15A) 28 VDC Missile Electronic Power

       Resistance of wire from CB to Relay Assembly

          52 ft. of #12 wire = .0988$\Omega$

       Maximum current available at 28 VDC = <u>283.4</u> A

    CB 1434 (60A) 28 VDC Missile Hydraulic Power

       Resistance of wire from CB to Relay Assembly

          52 ft. of #4 wire = .0137$\Omega$

       Maximum current available at 28 VDC = <u>2043.8</u> A

    CB 1401 (5A) 118 VAC AC Power

       Resistance of wire from CB to Relay Assembly

          52 ft. of #12 wire = .0988$\Omega$

       Maximum current available at 118 VAC = <u>1194.33</u>A

    CB 1394 (10A) 118 VAC Missile Heater Power

       Resistance of wire from CB to Relay Assembly

          52 ft. of #12 wire = .0988$\Omega$

       Maximum current available at 118 VAC = <u>1194.33</u>A

③   <u>Damage to Connector J2367 or Cable 31-3564-121</u>

The wire to pin 57 may be shorted to 28 VDC through CB 1450, CB 1444 or to 118 VAC through CB 1401 or CB 1394.

    CB 1444 (15A) 28 VDC Missile Electronic Power

       Resistance of wire from CB to Connector

          44 ft. of #12 wire = .0836$\Omega$

       Maximum current available at 28 VDC = <u>334.9</u> A

4.1.7.5b  (Continued)

    ③  (Continued)

        CB 1450 (7.5A) 28 VDC Bypass Valve Power

           Resistance of wire from CB to Connector

                44 ft. of #12 wire = .0836$\Omega$

           Maximum current available at 28 VDC = <u>334.9</u> A

        CB 1401 (5A) 118 VAC AC Power

           Resistance of wire from CB to Connector

                44 ft. of #12 wire = .0836 $\Omega$
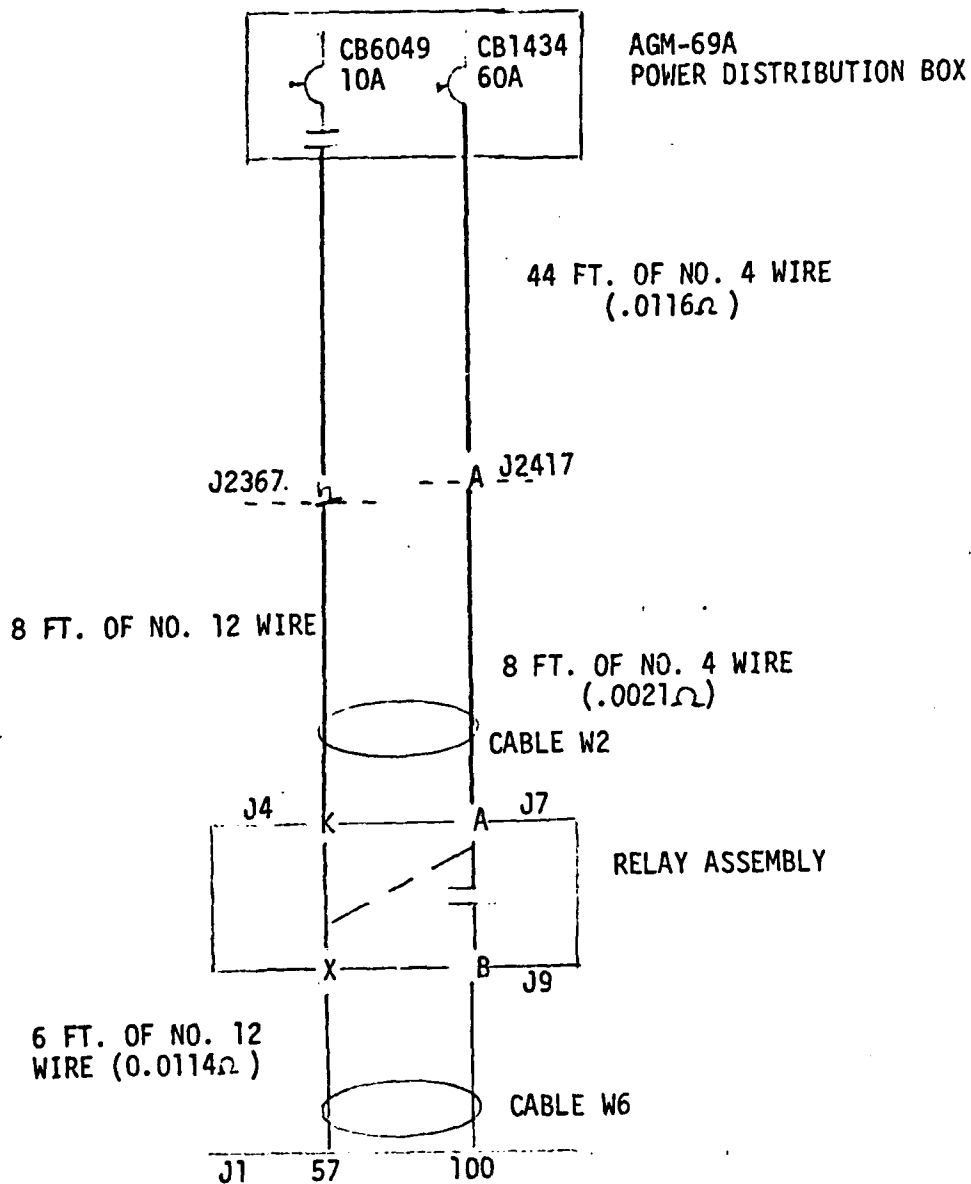
           Maximum current available at 118 VAC = <u>1141.5A</u>

        CB 1394 (10A) 118 VAC Missile Heater Power

           Resistance of wire from CB to Connector

                44 ft. of #12 wire = .0836 $\Omega$

           Maximum current available at 118 VAC = <u>1141.5A</u>

4.1.7.5   (Continued)

c.  Worst Case Path

(2)   Damage to Relay Assembly



Interface Pin 57

Total wire Resistance = 0.0251$\Omega$

Voc = 118 VAC

Isc = $\frac{118}{.0251}$ = 1115.5A

Time - Minimum trip time shown on calibration curve is 1.5 seconds for 500 amps.
Therefore the time for 1115.5 amps would be less than 1.5 sec.

FIGURE 4.1-59.  NETWORK TREE 153

A482  AGILL-69A
Pecied Distribution
Tray

CB6089
10 Amp
SK6482

③ ⊶ 31-3564-121

44' of #12
.0836 Ω

— — — H — — — J2367

③

⊶ W2

8' of #12
.0152 Ω

J4
K

②

RELAY
ASSEMBLY

X J9

0 Faults

W6
① 6' of #12
.0114 Ω
S7 J1

MISSILE No 1

FIGURE 4.1-60.    CABLE DRAWING

4.1.7.6    Circuit Analysis Package, AGM-69A Interface Pins 82, 92 &
           96 of Connector J1, Missile 1 on the Left Pylon

These interfaces are shown in Figure 5-7 and T.O. 16W6-19-2, Change 3.
The maximum current available to these pins in a normal environment is 0A
for ground alert and 254A for airborne conditions.  The worst case current
at 28VDC in an abnormal (faulted) environment would be 1115.5A with the
pins grounded.



Pin 82
Pin 92

Pin 96
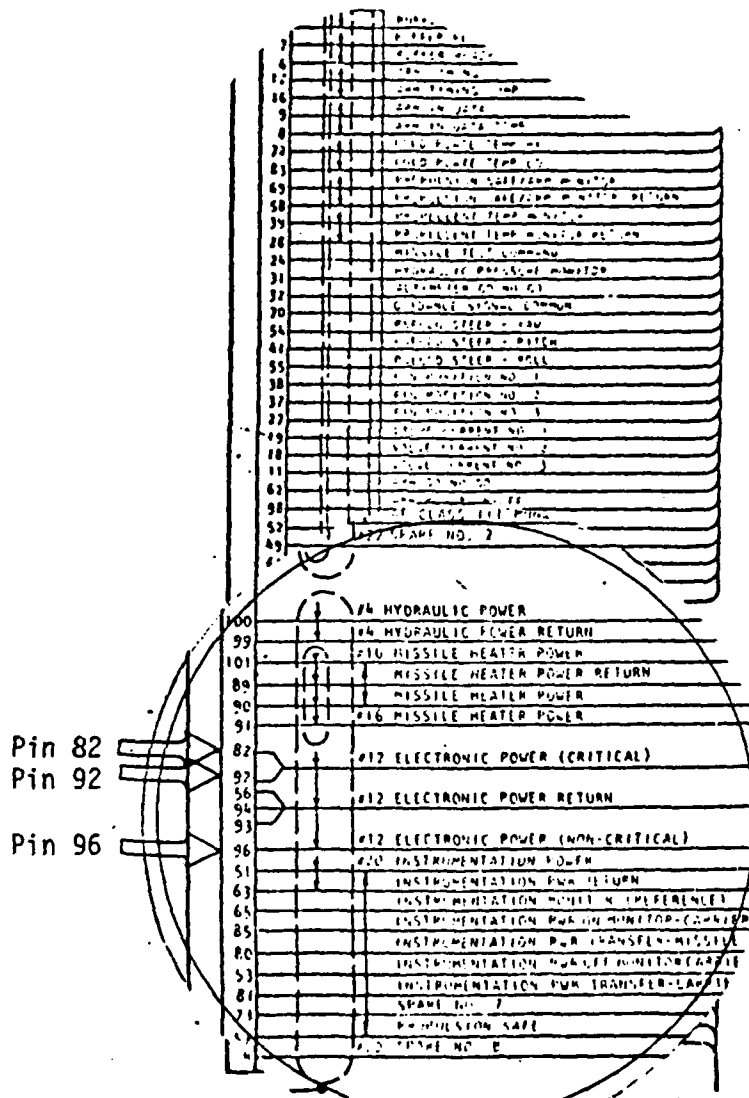
Refer to Figure 2-40
of T.O. 1B-52G-2-39GA-1
For Circuit Details

4.1.7.6    (Continued)

a.  Normal Power and Load Analysis

From examination of Figure 4.1-61, Network Tree 175, and Figure 4.1-62, open circuit voltage and short circuit current are:

Ground alert:   $V_{OC}$ = 0 VDC
(Missile OFF)
$I_{SC}$ = <u>0</u> A

Airborne:   $V_{OC}$ = 28VDC
(Missile ON)
$I_{SC}$ = <u>232</u>A

b.  Fault Analysis

The following postulated faults have been analyzed using Network Tree 175 and Cable Diagram, 4.1-61 and 4.1-62.

①    Damage to Connector J1 or Cable W6

Pins 82, 92 and 96 may be shorted to 118VAC through CB1394 if missile heater power is on.
CB1394 (10A) 118VAC Missile Heater Power
   Resistance of wire from CB to missile
      58 ft of #12 wire = .1102
   Resistance of relay contacts = .01
   Maximum current available at 118VAC = <u>981.7</u>A

②    Damage to Relay Assembly or Cable W2

The wires to the subject pins may be shorted to 28VDC through CB1450, CB1444 and CB1434. The wires may also be shorted to 118VAC through CB1401 and CB1394.

4.1.7.6b  (Continued)

        CB1450 (7.5A) 28VDC Bypass Valve Power

            Resistance of wire from CB to Relay Assembly

                52 ft of #12 wire = .0988

            Maximum current available at 28VDC = <u>283</u>A

        CB1444 (15A) 28VDC Missile Electronic Power

            Resistance of wire from CB to Relay Assembly

                52 ft of #12 wire = .0988

            Maximum current available at 28VDC = <u>283</u>A

        CB1434 (60A) 28VDC Missile Hydraulic Power

            Resistance of wire from CB to Relay Assembly

                52 ft of #4 wire = .0137

            Maximum current available at 28VDC = <u>2043</u>A

        CB1401(5A) 118VAC AC Power

            Resistance of wire from CB to Relay Assembly

                52 ft of #12 wire = .0988

            Maximum current available at 118VAC = <u>1194</u>A

        CB1394 (10A) 118VAC Missile Heater Power

            Resistance of wire from CB to Relay Assembly

                52 ft of #12 wire = .0988

            Maximum current available at 118VAC = <u>1194</u>A

③    <u>Damage to Connector J2367 or Cable 31-3564-121</u>

The wires to pins 82, 92, 96 may be shorted to 28VDC through CB1450 or to 118VAC through CB1401 or CB1394.

        CB1450 (7.5A) 28VDC Bypass Valve Power

            Resistance of wire from CB to Connector

                44ft of #12 wire = .0836

            Maximum current available at 28VDC = <u>334</u>A

4.1.7.6b    (Continued)

   ③    (Continued)

       CB1401 (5A) 118VAC AC Power

          Resistance of wire from CB to Connector

              44 ft of #12 wire = .0836

          Maximum current available at 118VAC = <u>1141</u>A .

       CB1394 (10A) 118VAC Missile Heater Power

          Resistance of wire from CB to Connector
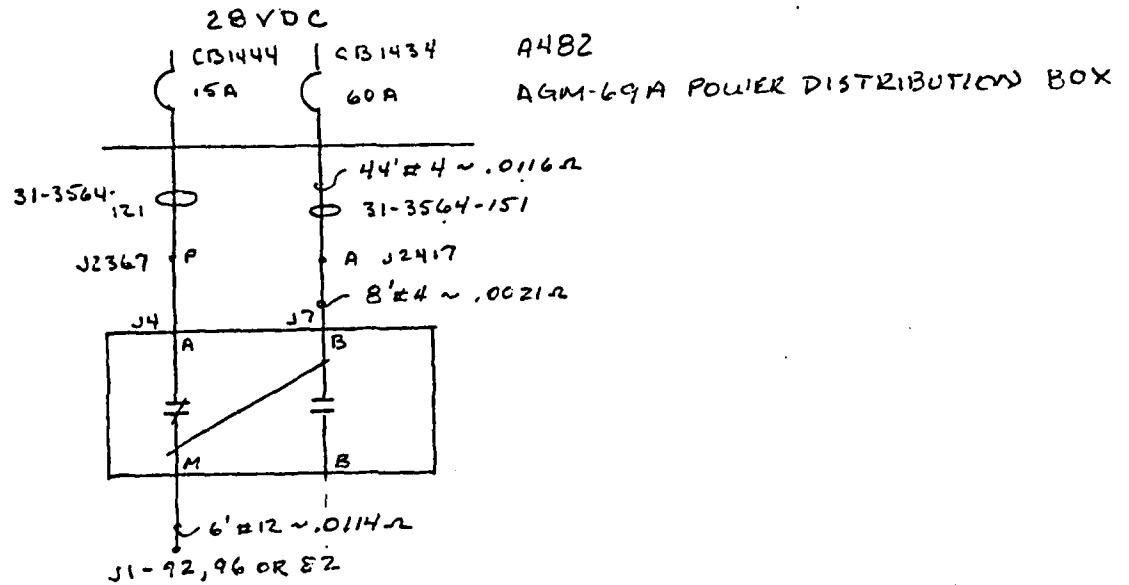
              44 ft of #12 wire = .0836

          Maximum current available at 118VAC = <u>1141</u>A

NOTE.  All circuit breakers are located in the AGM-69A Power Distribution
      Box.

4.1.7.6   (Continued)

c.   <u>Worst Case Path</u>

Reference path ② Damage to Relay Assembly



28 VDC

CB1444   CB1434      A482

15 A   60 A      AGM-69A POWER DISTRIBUTION BOX

44' #4 ~ .0116 Ω

31-3564-121

31-3564-151

J2367  P      A J2417

8' #4 ~ .0021 Ω

J4  A      J7  B

M      B

6' #12 ~ .0114 Ω

J1-92, 96 OR 82

Pins 82, 92, 96

Total resistance = 0.0251 Ω

$V_{OC}$ = 28VDC

$I_{SC}$ = <u>1115.5</u> A

Time = Minimum trip time shown in calibration curve is 1.5 seconds
for 500 A.  Trip time for 2413 A will be less than 1.5 seconds.

Figure 4.1   Network Tree No. 175

4-123

A482
AGM-69A Power
Distribution Box

CB 1444
15 AMPS

31-3564-121

.0836 Ω

P

J2367

③

W2

.0152 Ω

P6 ② 
J4

A

B1   A1

B2   A2

RELAY
ASSEMBLY

Y — M        J9

W6

.0114 Ω

①

J1

1  96   82  92

MISSILE No 1
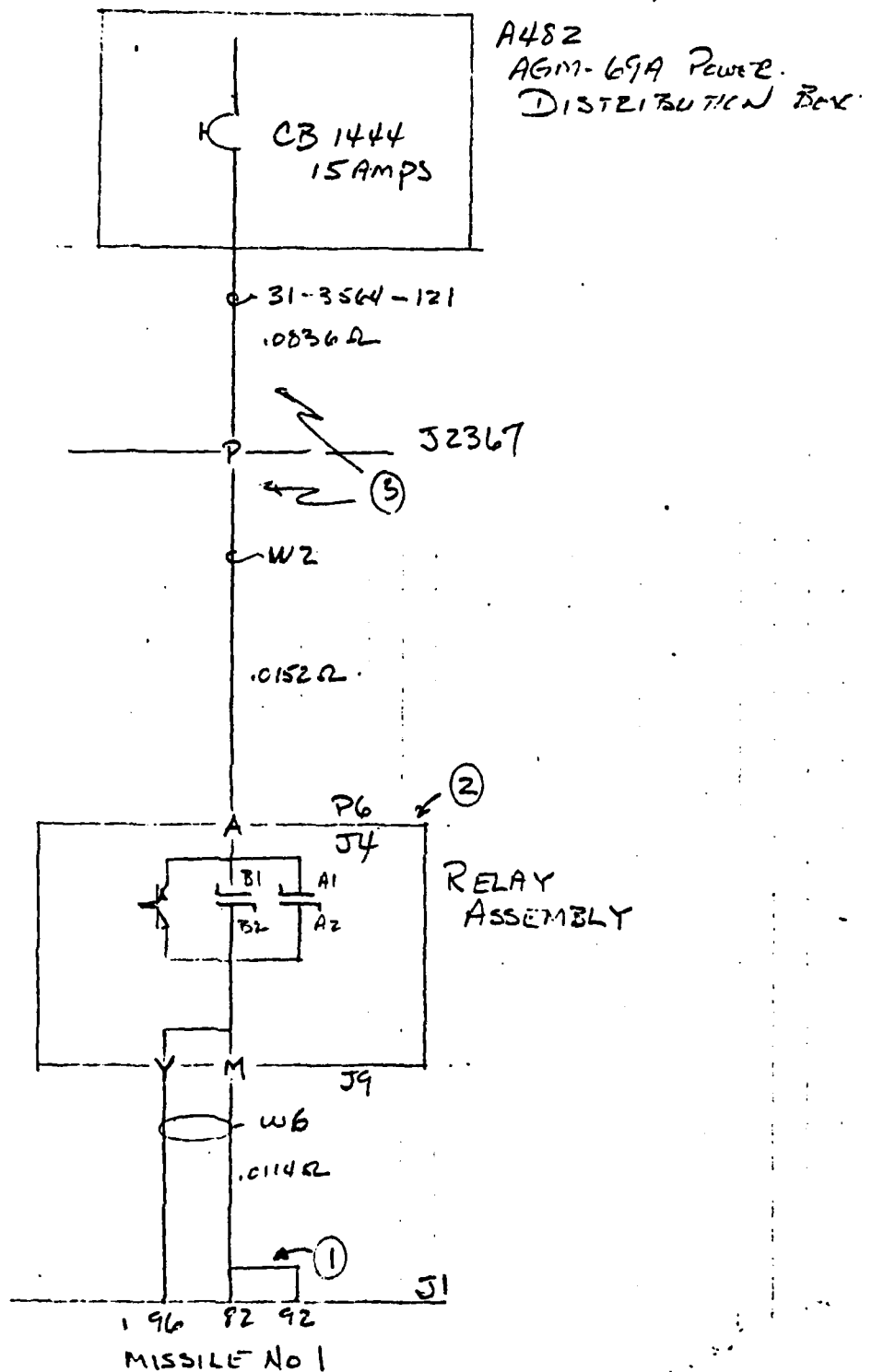
FIGURE 4.1-62.   CABLE DRAWING
4-124

THIS PAGE INTENTIONALLY BLANK

4.1.7.7   Circuit Analysis Package, AGM-69A Ejector Interface pin <u>r</u>,
          Arm Solenoid, Launcher and Pylon

These interfaces are shown in Figure 5-7 of T.O. 11L1-2-8-2, Change 12.
Maximum current available to this pin in a normal environment is <u>0</u> amps.
Worst case current at 27VDC in an abnormal (faulted) environment for the
launcher ejector pin is <u>54</u> amps and for the pylon ejector is <u>37</u> amps with
the pins grounded.
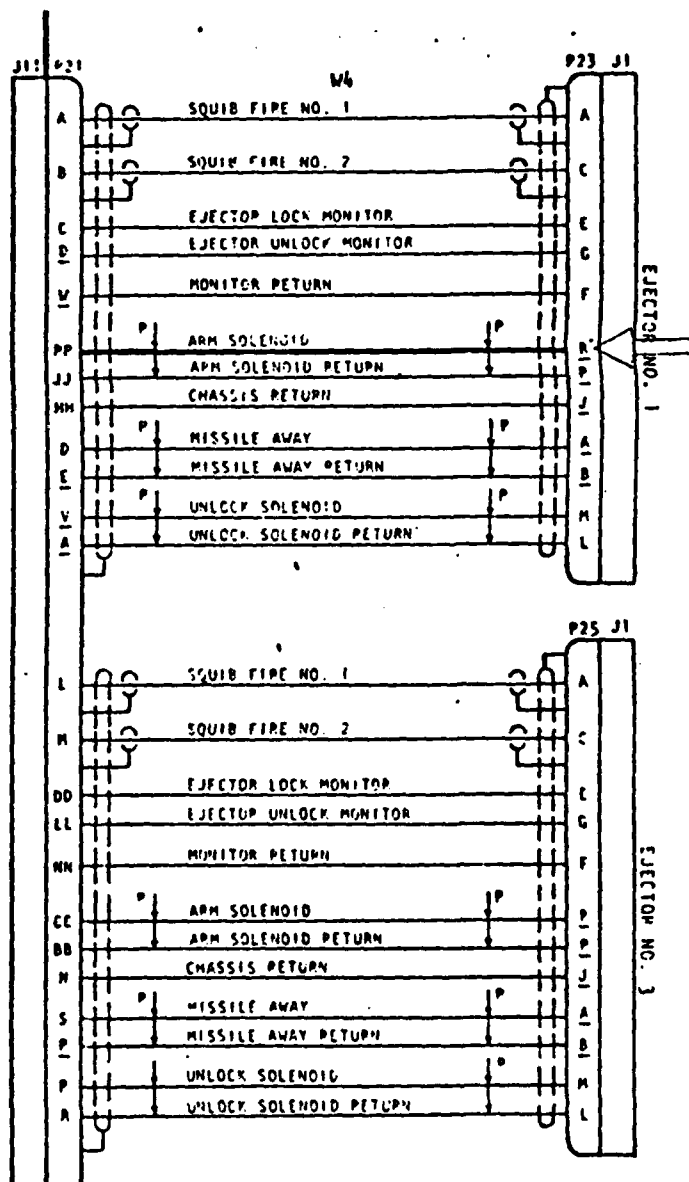


Refer to Figure 2-39 of
T.O. 1B-52G-39GA-1 for
Circuit Details.

4.1.7.7   (Continued)

a.   Normal Power and Load Analysis

From an examination of Figure 4.1-64, Cable Drawing, the open circuit voltage is 0V and the short circuit current is 0A.  The electronic switch is normally off prior to launch.

b.   Fault Analysis

The following faults were analyzed using Figure 4.1-64.

(1)   Cable W11 Damaged or (2) W4 Damaged

Wire to pin r shorted to missile away monitor from pin a.  Pin a is a ground path for the missile away monitor lamp located in the Weapon Release Indicator Panel, and a relay in the Switch Unit.  Current available to the interface cannot be calculated since value of current limiting resistor and other components in the circuit is unknown (schematics in the MCU are not available).

Guidance and Logic Signals

Current output from these sources is device limited and is less than expected from the above fault.

(3)   Launcher MCU Damaged

Wire to pin r shorted to 27VDC from CB1484, $\pm$ 22VDC from power supply in the switch unit or guidance and logic signals.

CB1484 (5A) 27VDC Essential Power

Resistance of wire from CB to MCU

44 ft of #20 wire = .405 ohms

Maximum current available = 66 amps

Power Supply in Switch Unit

Current output is less than above listed fault.  Current magnitude is unknown since specification is not available.

Guidance and Logic Signals

Current from these sources is  device limited to less than other sources listed.

4.1.7.7b (Continued)

④ Pylon MCU Damaged

Wire to pin r shorted to 27VDC from CB1483, ± 22VDC from power supply in Switch Unit or guidance and logic signals.

CB1485 (5A) 27VDC Essential Power

Resistance of wire from CB to MCU

50 ft of #20 wire .619 ohms

Maximum current available = 43.5 amps

Power supply in switch unit

Current output is less than other listed fault circuit

magnitude is unknown since specification is not available.

Guidance and Logic Signals

Current output from these sources is device limited to less than other sources listed.

c.    Fault Analysis

For launch ejector reference path ② Launcher MCU Damaged.



Total resistance of path = .5 ohms
$V_{OC}$ = 27VDC
$I_{SC} = \frac{27}{.5}$ = 54 amps
Time = 1.1 seconds maximum
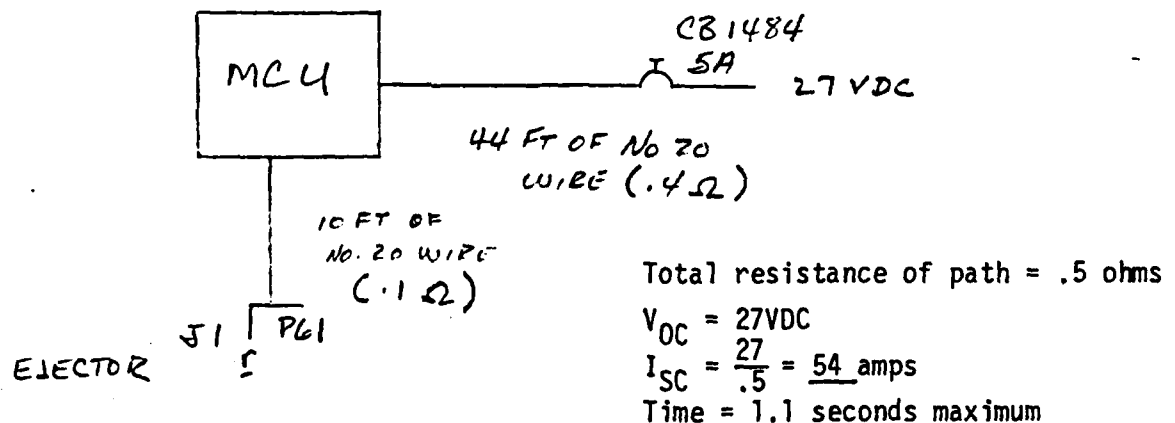
NOTE: All circuit breakers are located in the AGM-69A Power Distribution Box.

4.1.7.7   (Continued)

c.   (Continued)

For pylon ejector reference path④   Pylon MCU Damaged.



Total resistance of path = .72 ohms

$V_{OC}$ = 27VDC

$I_{SC} = \frac{27}{.72} = \underline{37}$ A
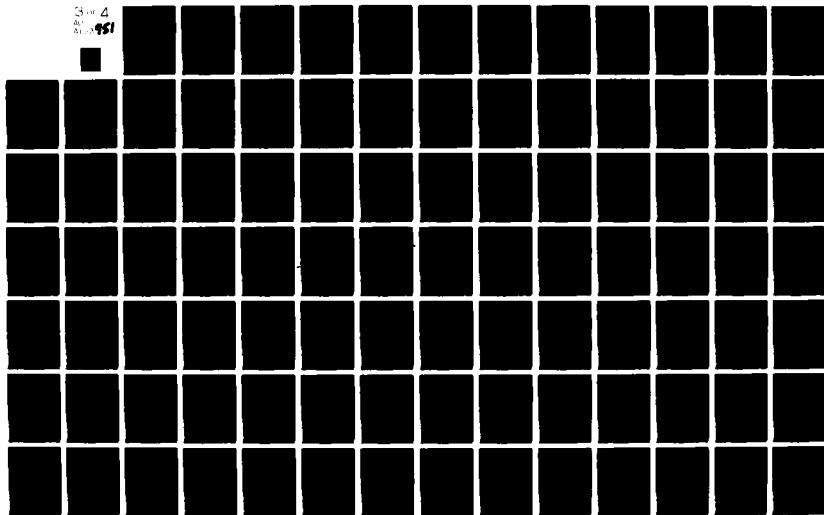
Time = 2.2 seconds maximum
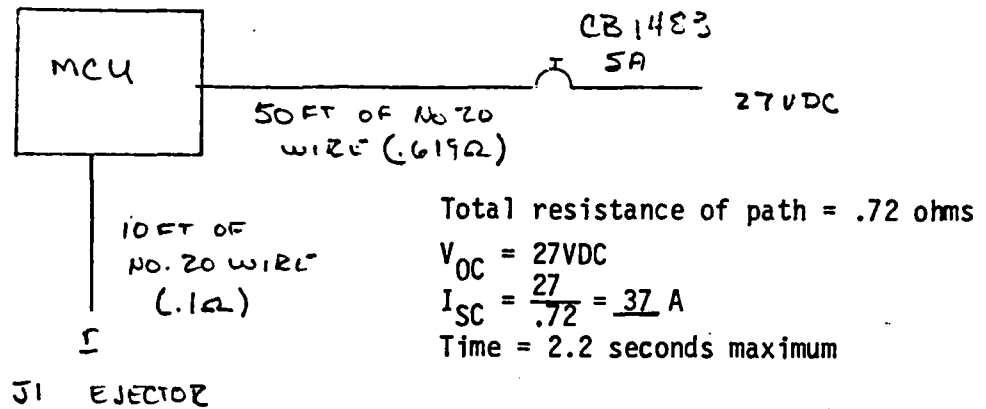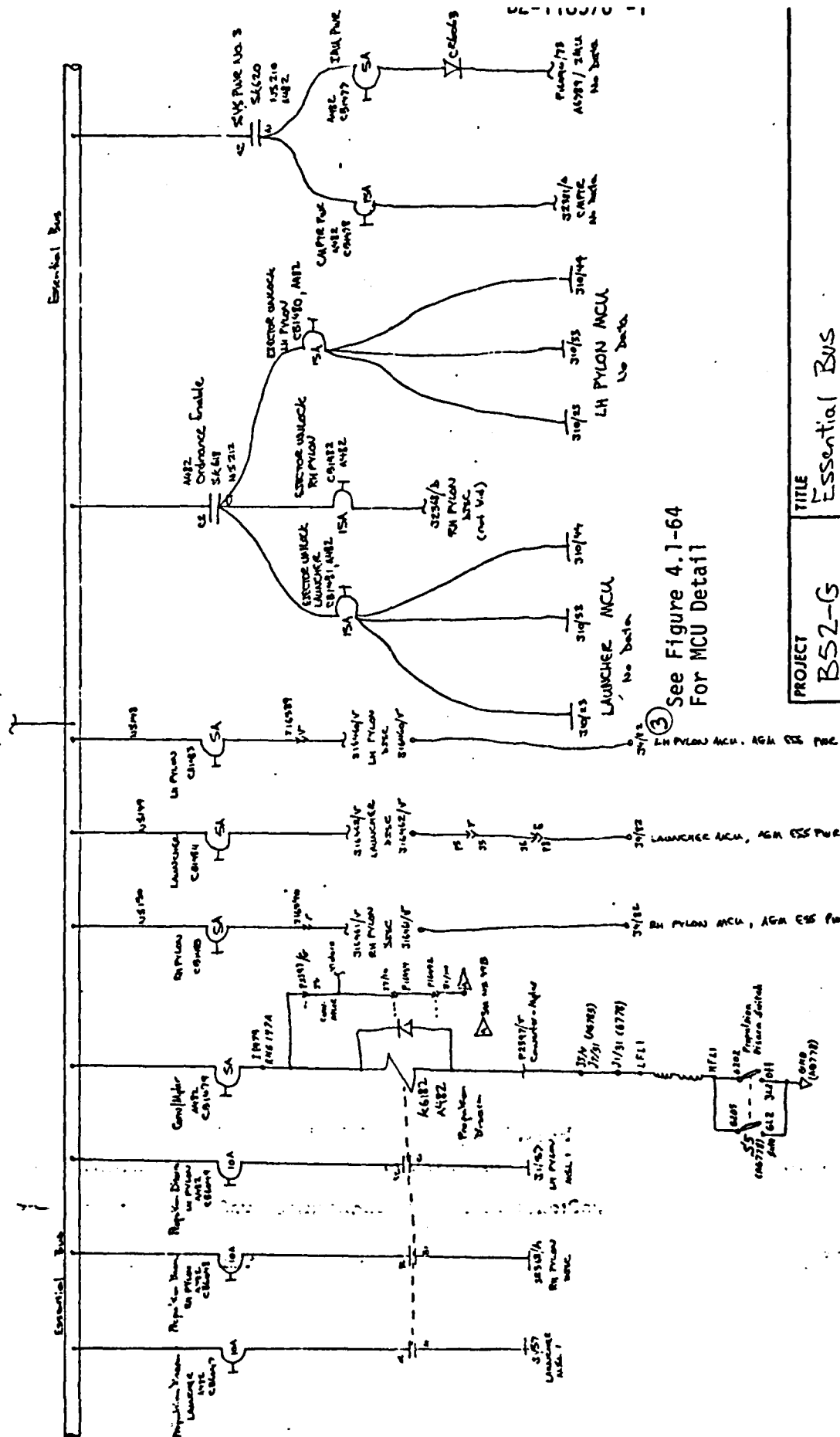
FIGURE 4.1-63. NETWORK TREE 148

4.1.7.7    (Continued)

Launcher Ejector shown
For pylon ejector:

J11 is J11
P59 is P21
W11 is W4
P61 is P23
J1 is J1
① is ②
③ is ④

DIGITAL DATA COMMANDED
DURING LAUNCH PHASE

ESSENTIAL BUS
(ON)

③

J11
P59

W11  ①

P61
J1  EJECTOR
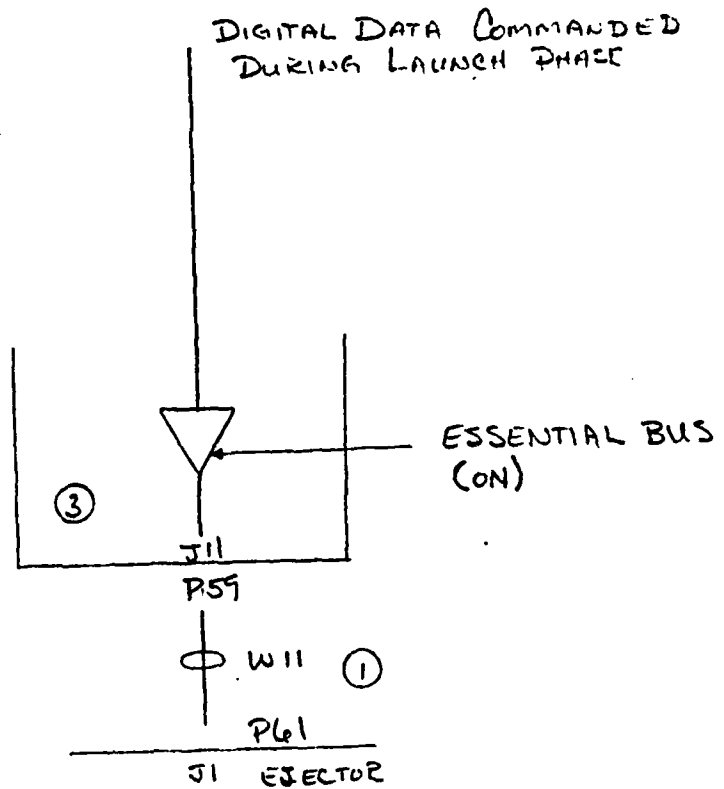
0 Faults

FIGURE 4.1-64    CABLE DIAGRAM

4.1.7.8    Circuit Analysis Package, AGM-69A Interface pins 20 and 60,
           Connector J1, Missile #1 On the Launcher and Left Pylon

This interface is shown in Figure 5-37 and T.O. 11L1-2-8-2, (Change 12).
Maximum current available to these pins in a normal environment is 0A.
Worst case current at 118VAC in an abnormal (faulted) environment assuming the
pins grounded would be:

    Launcher missile pins - 900A

    Pylon missile pins    - 983A
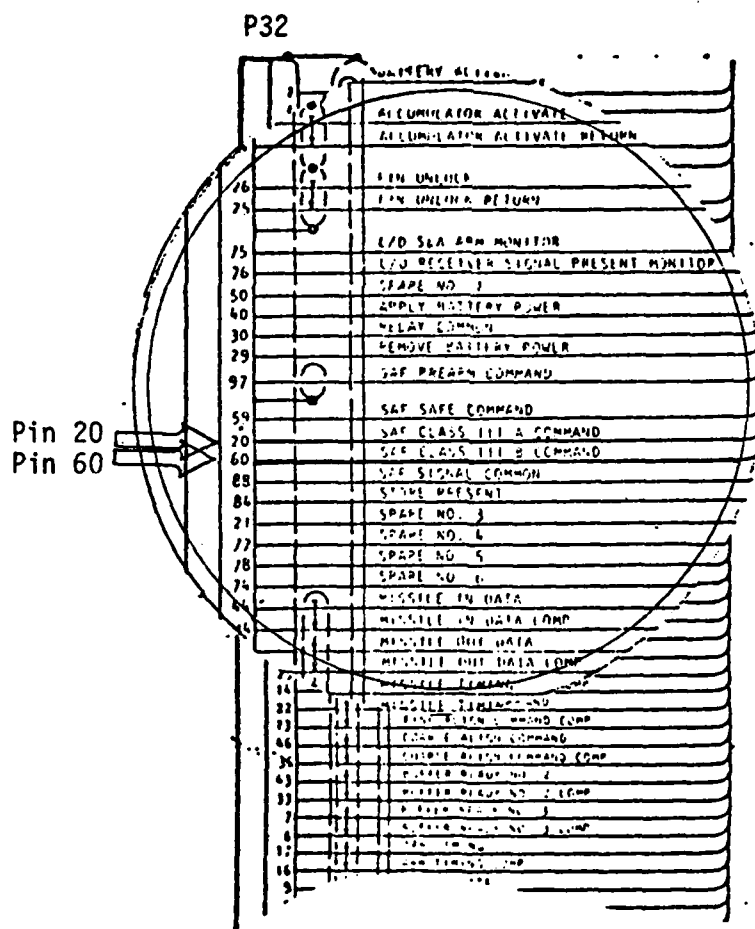


Refer to Figure 2-38 of
T.O. 1B-52G-39GA-1 For
Circuit Details

4.1.7.8  (Continued)

a.  <u>Normal Power and Load Analysis</u>

From an examination of Figure 4.1-65, Cable Drawing, the open circuit voltage is OV and the short circuit current is <u>OA</u>. The electronic switches are normally off prior to the launch phase.

b.  <u>Fault Analysis</u>

The following faults were analyzed using Figure 4.1-65.

For Launcher Mounted Missile

①  <u>Cable W1 Damaged</u>

Wires to pins 20 and 60 shorted to 28VDC from CB1411, 118VAC from CB1395 if heater power is on, or to guidance and logic signals.

CB1411 (15A) 28VDC Missile Electronic Power

    Resistance of wire from CB to missile interface

        55 ft of #10 wire = .06 $\Omega$

        switch          = .01 $\Omega$

    Maximum current available = <u>400A</u>

CB1395 (15A) 118VAC Missile Heater Power

    Resistance of wire from CB to missile interface

        47 ft of #12 wire = .095 $\Omega$

        6 ft of #16 wire = .027 $\Omega$

    Maximum current available = <u>940A</u>

Guidance and Logic Signals

Currently output of these sources is device limited to less than other sources listed.

4.1.7.8b  (Continued)

&#9313;  <u>Launcher MCU Damaged</u>

Wires to pins 20 and 60 shorted to 27VDC from CB1484, $\pm$ 22VDC from Power Supply in the Switch Unit, or guidance and logic signals.

CB1484 (5A) 27VDC Essential Power
    Resistance of wire from CB to MCU
        44 ft of #20 wire = .405 $\Omega$
    Maximum current available = <u>66A</u>

Power Supply in Switch Unit

Current output is less than the other listed faults.  Current magnitude unknown, specifications not available.

Guidance and Logic Signals

Current output from these sources is limited to less than other sources listed.

For Pylon Mounted Missile

&#9312;  <u>Cable W6 Damaged</u>

Wires to pins 20 and 60 shorted to 28VDC from CB1444, 118VAC from CB1394 if heater power is on, or guidance and logic signals.

CB1444 (15A) 28VDC Missile Electronic Power
    Resistance of wire from CB to missile interface
        58 ft of #20 wire = .11 $\Omega$
        switch           = .01 $\Omega$
    Maximum current available = <u>233A</u>

CB1394 (10A) 118VAC Heater Power
    Resistance of wire from CB to missile interface
        58 ft of #12 wire = .11 $\Omega$
        switch           = .01 $\Omega$
    Maximum current available = <u>983A</u>

4.1.7.8b  (Continued)

Guidance and Logic Signals

Current output from these sources is limited to less than other sources listed.

② <u>Left Pylon MCU Damaged</u>

Wires to pins 20 and 60 shorted to 27VDC from CB1483, $\pm$ 22VDC from power supply in switch unit, or guidance and logic signals.

CB1483 (5A) 27VDC Essential Power
  Resistance of wire from CB to MCU
    50 ft of #20 wire = .619 $\sim$
  Maximum current available = <u>43.5A</u>

Power Supply in Switch Unit

Current output less than other listed fault.  Current magnitude unknown, specifications not available. ·

Guidance and Logic Signals

Current output from these sources is limited to less than other sources listed.

Note: All circuit breakers are located in the AGM-69A Power Distribution Box

4.1.7.8   (Continued)

c.   <u>Worst Case Paths</u>

For Launcher Mounted Missile
    Reference Path ① Cable W1 Damaged
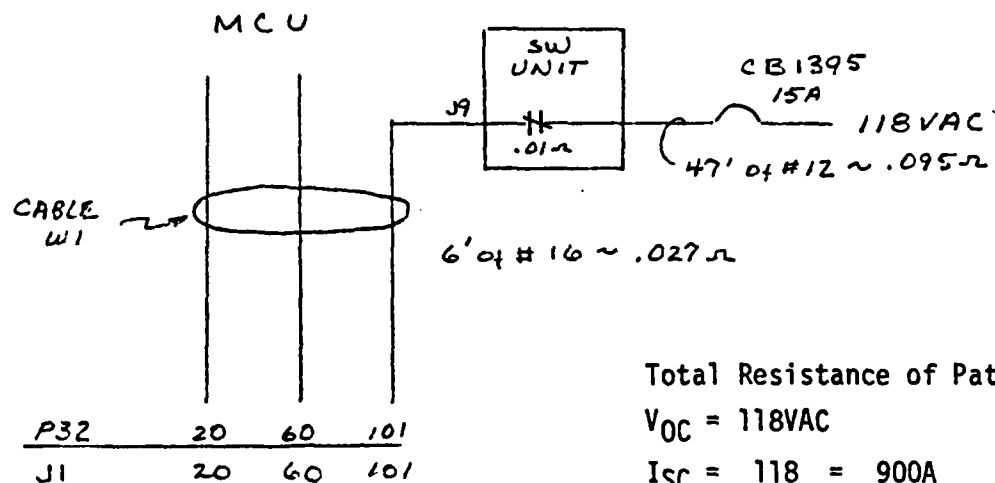


Total Resistance of Path .122 Ω

$V_{OC}$ = 118VAC

$I_{SC} = \dfrac{118}{.122} = \underline{900A}$

Time - Current rating exceeds 6000% rating of CB.  The time will be less than .13 sec (300% rated).

For Pylon Mounted Missile
    Reference path ① Cable W6 Damaged
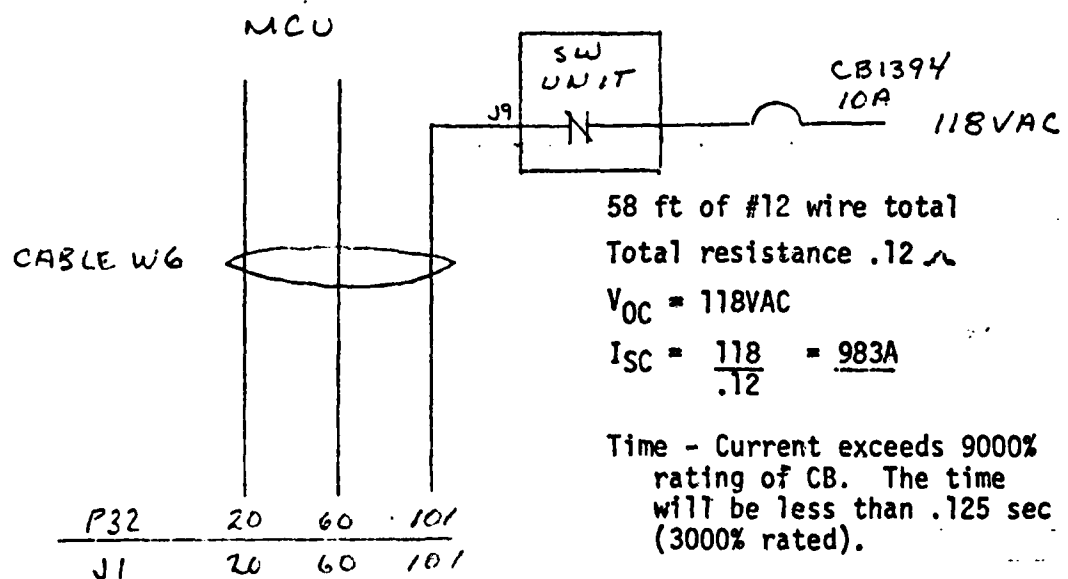


58 ft of #12 wire total

Total resistance .12 Ω

$V_{OC}$ = 118VAC

$I_{SC} = \dfrac{118}{.12} = \underline{983A}$

Time - Current exceeds 9000% rating of CB.  The time will be less than .125 sec (3000% rated).

4.1.7.8c (Continued)

NOTE: CABLING AND CONNECTORS ARE SHOWN
FOR MISSILE #1 MOUNTED IN THE
LAUNCHER.  FOR MISSILE MOUNTED ON
THE LEFT PYLON:

W1  IS W6
P24 IS P15
P32 IS P32
J1  IS J1

SIGNALS GENERATED INTERNALLY
TO MCU

SAF CLASS III UP COMMAND

SAF CLASS III DN COMMAND

ELECTRONIC
SWITCHES

27VDC ESSENTIAL PWR -

MCU ②

CABLE W1
①

FAULT

P32 20      60
J1  20      60
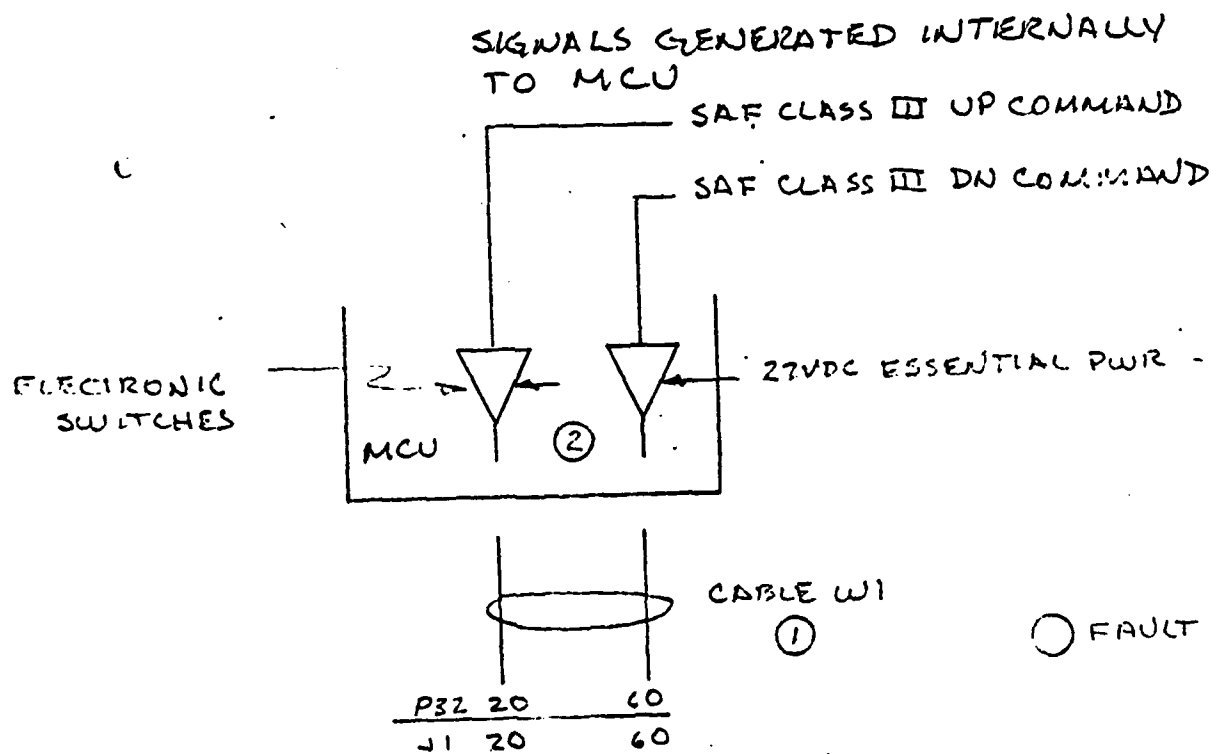
FIGURE 4.1-65.   CABLE DRAWING

## 4.2    POWER AND LOAD ANALYSIS - FB-111A

This section describes the power and load analyses of monitor and control
circuits leading to gravity weapons loaded on weapon station 3 pivot pylon
and in RH weapons bay. These two weapons stations were picked as typical
for all nuclear weapons stations and represent both the nearest and
farthest station from the power sources. Potential worst case currents at
weapon stations 4 and 5 would be slightly higher (approximately 12%) than
those calculated for weapon station 3 due to differences in wire length.
Figure 4.2-A is a simplified schematic diagram of the circuits to the
Aircraft Monitor and Control - station program unit (AMAC SPU) interface
connector. Numbers opposite the interface pins refer to circuit analysis
packages in section 4.2.6 herein. Figure 4.2-B is an exploded view of an
AMAC SPU, typical for all stations. Figure 4.2-C locates the pivot pylon
weapon station AMAC SPU. Figure 4.2-D is a copy of Figure 1-8 from
T.O. 1F-111(B)A-2-11-1 showing the circuitry to the pivot pylon weapons
station. Note that the pins at the bottom of the diagram are the weapon
interface pins. Figure 4.2-E locates the weapons bay AMAC SPU's.

Figure 4.2-F shows weapons bay interface circuitry. Note that the
pins at the bottom of the diagram interface with the weapon. The main
difference between the -3 pivot pylon interface and -R right hand wea-
pons bay interface is the presence of interconnect pins V and W at the
pylon. See Appendix A for a list of all technical data utilized for the
FB-111A-Power and Load Analysis.

### 4.2.1    SUMMARY

Power and load analyses of network trees generated by sneak circuit analysis
are documented in section 4.2.6 below. Table 4.2-1A, sheets 1 and 2,
provide a summary of the results.

### 4.2.2    CONDITIONS

The following conditions and exclusions are applicable to the FB-111A
Analysis.

TABLE 4.2-1A Power and Load Analysis Results – FB-111/Station 3
(Sheet 1 of 2)

| WEAPON INTERFACE | | NORMAL | | | ENVIRONMENT ANALYSIS RESULTS | | | |
| DESIGNATOR | FUNCTION | V | I | t | ABNORMAL V | WORST CASE I | t | ANALYSIS PACKAGE Section 4.2.6 |
|---|---|---|---|---|---|---|---|---|
| J479013-3 | WPN STATION 3 | | | | | | | |
| Pin A | SAFE INPUT | 28V | 608A | .6s | 28V / 115VAC | 608A / 1983A | .6s / .6s | 4.2.6.2 |
| B | (NONE) | | | | | | | |
| C | SAFE INDICATION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s/-* | 4.2.6.5 |
| D | (NONE) | | | | | | | |
| E | GROUNDED | 0 | – | | | | | |
| F | GROUNDED | 0 | – | | | | | |
| G | WPN PRESENT (GROUND) | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s/-* | 4.2.6.5 |
| H | ARM INPUT | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| J | ARM INPUT | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| K | (NONE) | | | | | | | |
| L | (UNUSED) | 0 | | | 28V / 115VAC | 608A / 451A | .6s/.6s | 4.2.6.3 |
| M | (NONE) | | | | | | | |
| N | (UNUSED) | 0 | | | 28V / 115VAC | 608A / 451A | .6s/.6s | 4.2.6.3 |
| P | PAL MONITOR | 28V | 48mA | | 28V / 115VAC | 608A / 451A | .6s/.6s | 4.2.6.1 |
| R | ARM INDICATION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s/-* | 4.2.6.5 |
| S | SWITCHED TO GROUND | 0 | | | 28V | 608A | .6s | 4.2.6.6 |
| T | (NONE) | | | | | | | |
| U | (NONE) | | | | | | | |
| V | PYLON CONTINUITY | 0 | 0 | | 28V | 608A | .6s | 4.2.6.6 |
| W | PYLON CONTINUITY | 0 | 0 | | 28V | 608A | .6s | 4.2.6.6 |
| X | WPN DROP CONFIG. RETARD | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| Y | (FUTURE CAPABILITY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| Z | BURST OPTION-AIR | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| a | (SRAM ONLY) | 0 | | | 28V | 608A | .6s | 4.2.6.3 |
| b | SAFE PROVISION | 28V | 48mA | | 28V / 115VAC | 608A / 198mA | .6s/-* | 4.2.6.4 |
| c | (SRAM ONLY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.3 |
| d | WPN DROP CONFIG. FREE FALL | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| e | (FUTURE CAPABILITY) | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |
| f | BURST OPTION-GND | 0 | 0 | | 28V | 608A | .6s | 4.2.6.2 |

*Indefinite

TABLE 4.2-1A Power and Load Analysis Results - FB-111/Station -R
Weapon Interface   (Sheet 2 of 2)

| WEAPON INTERFACE | | ENVIRONMENT ANALYSIS RESULTS | | | | | | ANALYSIS PACKAGE |
| DESIGNATOR | FUNCTION | NORMAL | | | ABNORMAL - WORST CASE | | | Section 4.2.6 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | V | I | t | V | I | t | |
| J479013-R | RH WPNS BAY | | | | | | | |
| Pin A | SAFE INPUT | 28V | 1333A | .6s | 28V / 115VAC | 1333A / 3286A | .6s / .6s | 4.2.6.2 |
| B | (NONE) | | | | | | | |
| C | SAFE INDICATION | 28V | 48mA | -- | 28V / 115VAC | 1333A / 198mA | .6s / Indefinite | 4.2.6.5 |
| D | (NONE) | | | | | | | |
| E | GROUNDED | | | | | | | |
| F | GROUNDED | | | | | | | |
| G | WPN PRESENT (GND) | 28V | 48mA | -- | 28V / 115VAC | 1333A / 198mA | .6s / Indefinite | 4.2.6.5 |
| H | ARM INPUT | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| J | ARM INPUT | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| K | (NONE) | | | | | | | |
| L | (UNUSED) | 0 | 0 | -- | 28V / 115VAC | 1333A / 215A | .6s / .6s | 4.2.6.3 |
| M | (NONE) | | | | | | | |
| N | (UNUSED) | 0 | 0 | -- | 28V / 115VAC | 1333A / 215A | .6s / .6s | 4.2.6.3 |
| P | PAL MONITOR | 28V | 48mA | -- | 28V | 1333A | .6s | 4.2.6.1 |
| R | ARM INDICATION | 28V | 48mA | -- | 28V | 1333A | .6s | 4.2.6.5 |
| S | SWITCHED TO GND | 0 | 0 | -- | 115VAC / 28V | 198mA / 1333A | Indefinite / .6s | 4.2.6.6 |
| T | (NONE) | | | | | | | |
| U | (NONE) | | | | | | | |
| V | (UNUSED IN WPN BAY) | | | | | | | |
| W | (UNUSED IN WPN BAY) | | | | | | | |
| X | WPN DROP CONFIG. RET | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| Y | (FUTURE CAPABILITY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| Z | BURST OPTION-AIR | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| a | (SRAM ONLY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.3 |
| b | SAFE PROVISION | 28V | 48mA | -- | 115VAC / 28V | 198mA / 1333A | Indefinite / .6s | 4.2.6.4 |
| c | (SRAM ONLY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.3 |
| d | WPN DROP CONFIG-FF | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| e | (FUTURE CAPABILITY) | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |
| f | BURST OPTION - GND | 0 | 0 | -- | 28V | 1333A | .6s | 4.2.6.2 |

Figure 4.2-A   Simplified Schematic - Circuits to AMAC SPU

**VIEW FROM
RELAY SIDE**

1.  SCREW
2.  LOCKWASHER
3.  TERMINAL RING
4.  WASHER
5.  NUT
6.  CAN ASSEMBLY
7.  SCREW (12)
8.  LOCKWASHER (12)
9.  WASHER (12)
10. SCREW (6)
11. LOCKWASHER (6)
12. WASHER (6)
13. CONNECTOR (J479011)
14. CONNECTOR (J479012)
15. CONNECTOR (J479013)
16. RELAY SOCKET
17. MOUNTING PLATE ASSEMBLY
18. PROGRAM CONNECTOR ASSEMBLY
19. LOCKWASHER (5)
20. WASHER (5)
21. "O" RING
22. RELAY
23. RELAY SPACER
24. SOCKET SPACER (5)
25. COVER ASSEMBLY
26. SCREW (5)

Figure 2-2.  Station Program Unit Exploded View

2-3

Figure 4.2-B  Typical AMAC SPU

4-142

1.  ACCESS DOOR
2.  PIVOT PYLON
3.  ELECTRICAL CONNECTORS (2)
4.  WASHER (2)
5.  BOLT (2)
6.  AMAC SPU.
7.  COVER
8.  STOW PLUG (FOR COVER ITEM 7 ONLY)
9.  NUCLEAR WEAPONS SIMULATOR PLUG
10. KEYWAY
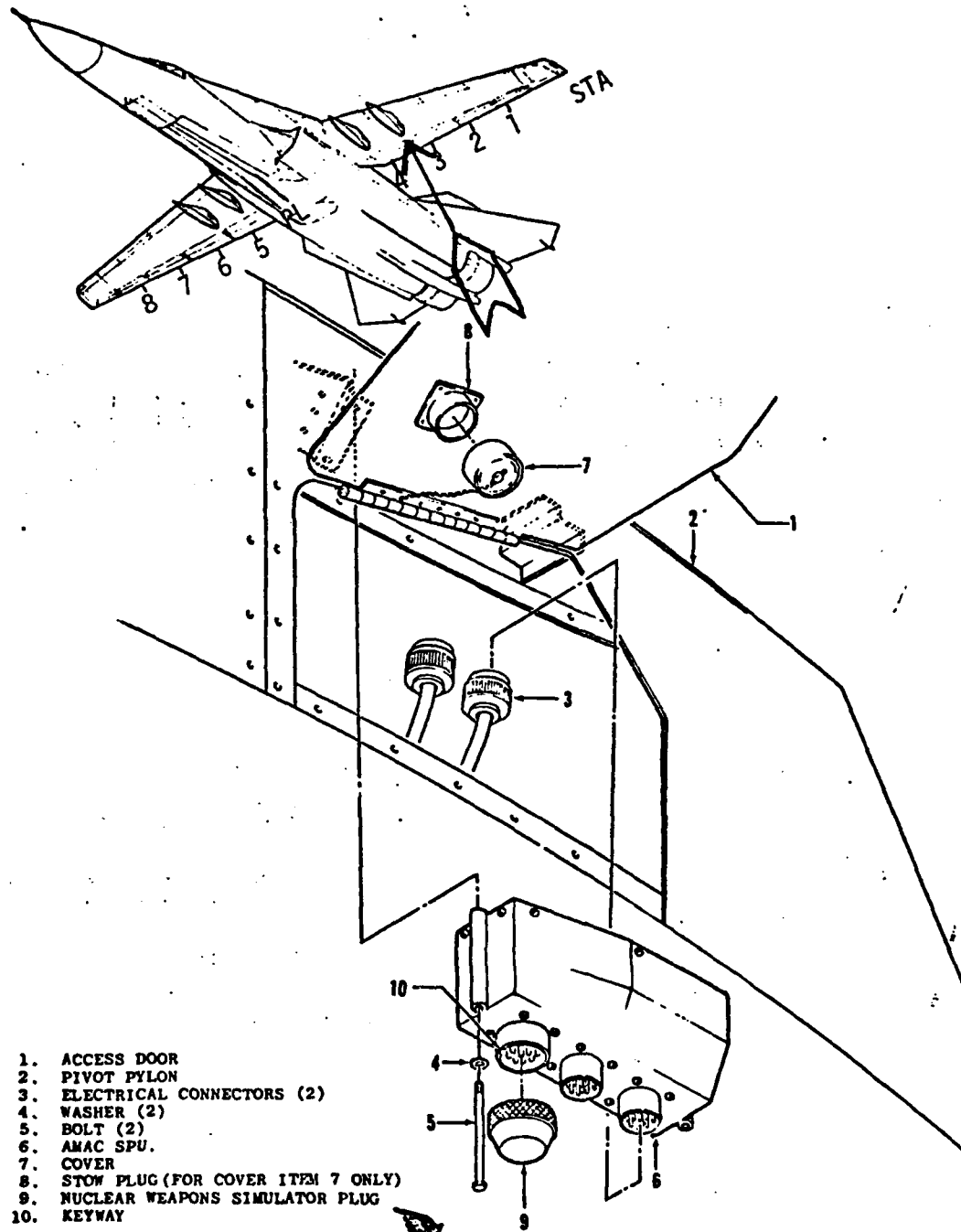
Figure 5-37.   Pivot Pylon AMAC SPU and Nuclear Weapons Simulator Plug Removal and Installation

Figure 4.2-C  Pivot Pylon AMAC SPU Location

Figure 4.2-D  Weapon Station 3 Circuitry
(Sheet 1 of 3)

DETAIL B

Figure 4.2-D   Weapon Station 3 Circuitry
(Sheet 2 of 3)

D2-118576 .-1
T.O. 1F-111(B)A-2-11-1

CHANGE LEGEND
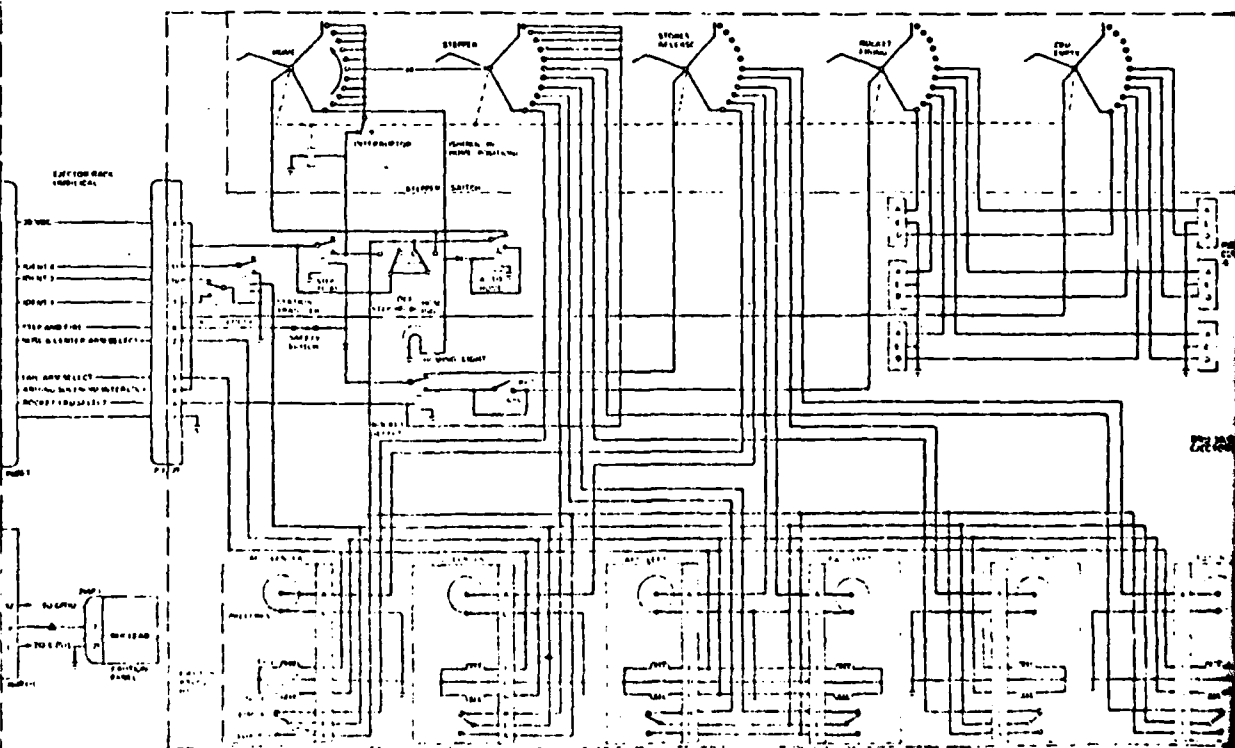
NOTES



Figure 4.2-D   Weapon Station 3 Circuitry
(Sheet 3 of 3)

Figure 1-8.   Stores Management System Pivot Pylon Integrated Schematic Diagram

RIGHT WEAPONS
BAY CAVITY

RIGHT WEAPONS BAY
AMAC SPU

LEFT WEAPONS
BAY CAVITY

LEFT WEAPONS BAY
AMAC SPU

1. MOUNTING BRACKET
2. LEFT WEAPONS BAY
   AMAC SPU
3. WASHER (2)
4. BOLT (2)
5. ELECTRICAL CONNECTOR (3)
6. KEYWAY
7. DUST COVER
8. NUCLEAR WEAPONS SIMULATOR PLUG

LEFT SIDE SHOWN
RIGHT SIDE TYPICAL
ROTATED FOR CLARITY
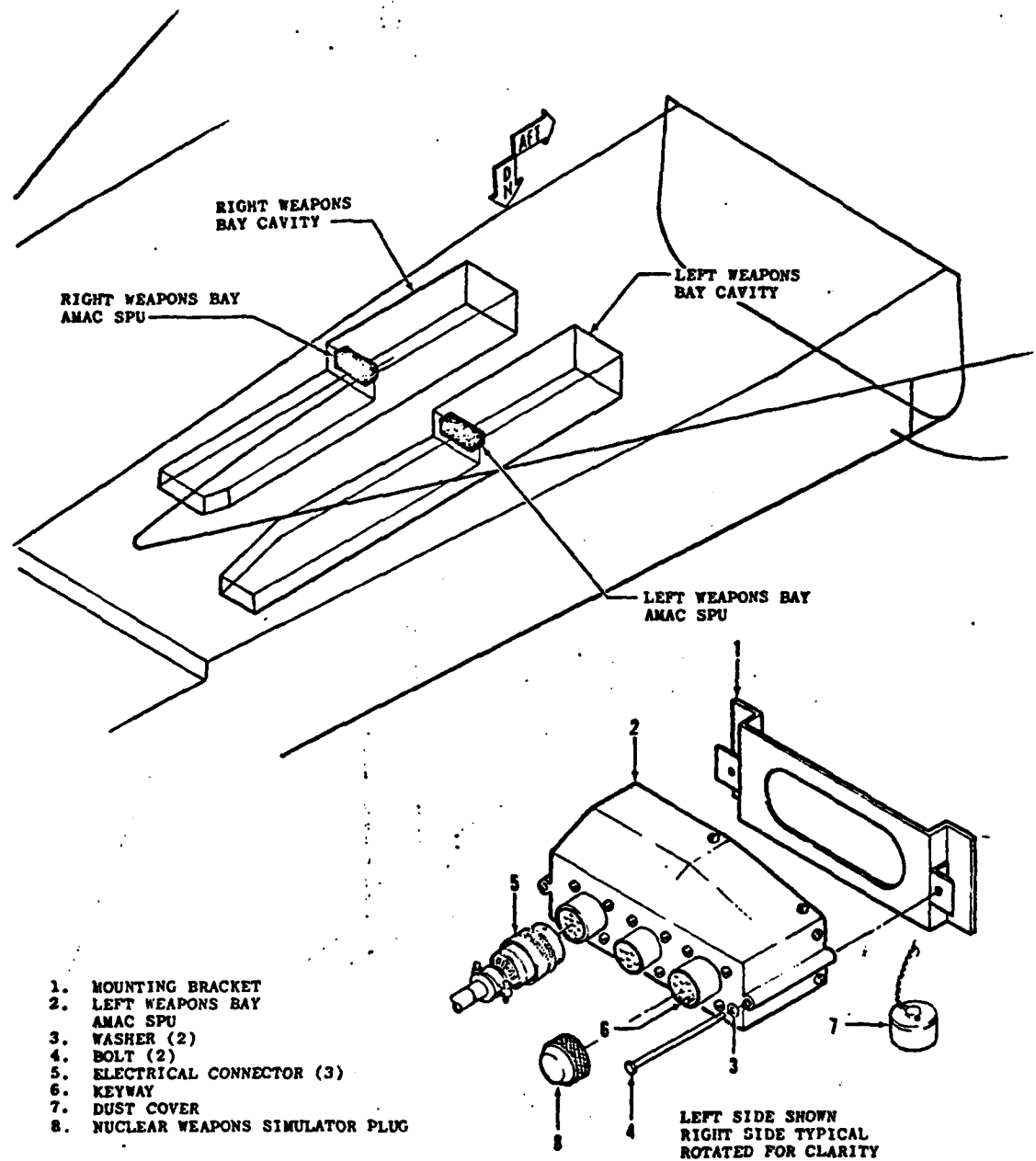
P7800000-9008C

Figure 5-36.   Weapons Bay AMAC SPU and Nuclear Weapons Simulator Plug Removal and Installation

5-189

Figure 4.2-E   Weapons Bay AMAC SPU Location

NOTES

1  DIAGRAM APPLICABLE TO WEAPON STATIONS L AND R.

2  ◯ INDICATES PLUG AND/OR NUMBER IS STATION-DEPENDENT. SEE INDEX

3  (*) INDICATES PLUG JACK NUMBERS ON LRU ARE IDENTICAL EXCEPT FOR LAST DIGIT. LAST DIGIT OF PLUG JACK OCCUPIES JACK COLUMN ADJACENT TO PIN NUMBER

⚠ FOR LEFT WEAPONS BAY, BREAK AT X AND USE DASHED LINES.

5  ⚠ INDICATES JUNCTION FOR ALL OTHER AMAC STATIONS

6  CAPITAL LETTERS WITH UNDERLINE DENOTE LOWER CASE LETTERS FOR PIN DESIGNATION

7  FOR CIRCUIT BREAKER LOCATION SEE FIGURE 5-1

⚠ PRIOR TO T.O. 1F-111(B)A-659

⚠ AFTER T.O. 1F-111(B)A 659

⚠ WIRING REMOVED AFTER T.O. 1F-111(B)A 659

⚠ CONNECTS TO PIN 41 ONLY

Figure 1-10.  Stores Management System Weapons Bay Integrated Schematic
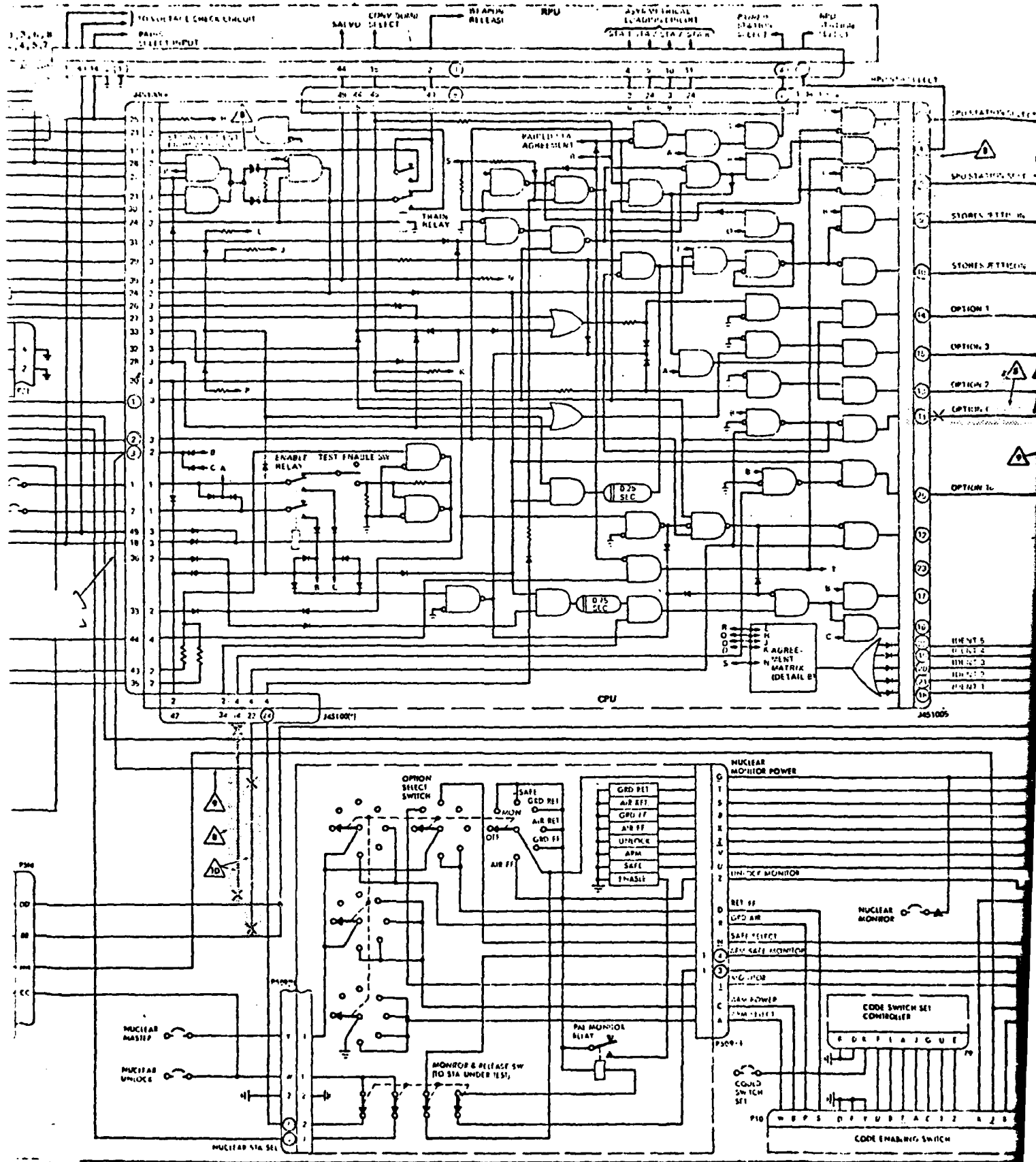
Figure 4.2-F  Weapon Station R Circuitry
(Sheet 1 of 4)

A-148

Figure 4.2-F  Weapon Station R Circuitry
(Sheet 2 of 4)

Figure 4.2-F   Weapon Station R Circuitry
(Sheet 3 of 4)

DETAIL B

EXTERNAL STORES JETTISON SWITCH INPUTS

CPU

CHANGE LEGEND

THIS ILLUSTRATION HAS BEEN EXTENSIVELY CHANGED
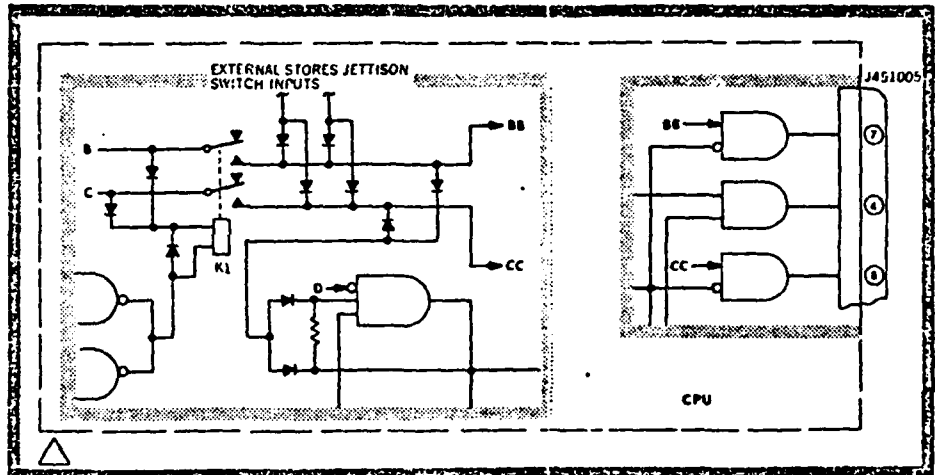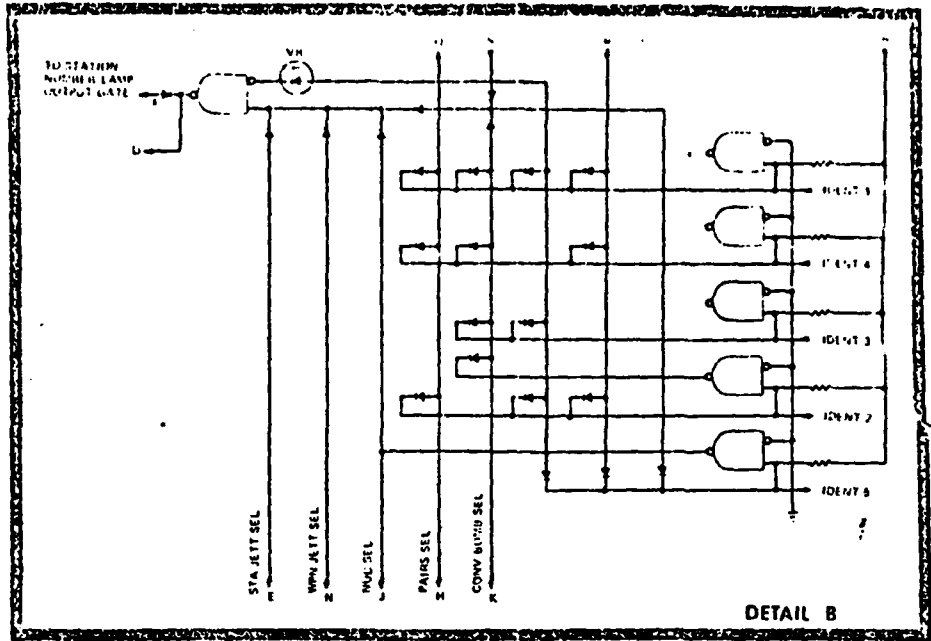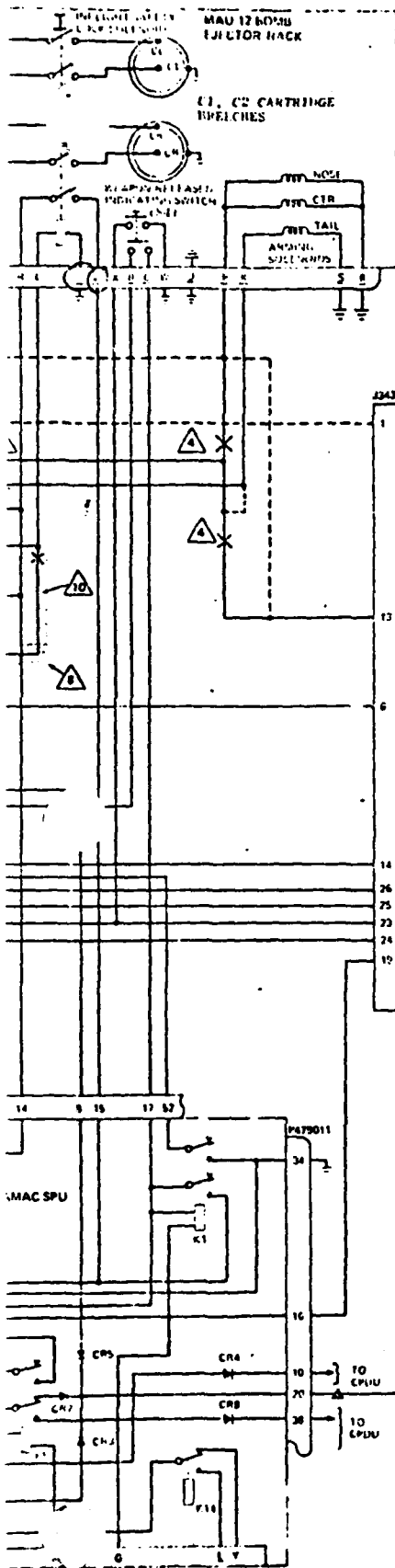
| INDEX TO STATION DEPENDENT PLUGS AND PIN NUMBERS | | | | | |
|---|---|---|---|---|---|
| STORES CONTROL PANEL | | | CPU | | |
| INDEX | L | R | INDEX | L | R |
| 1 | PIN 21 | PIN 22 | 1 | PIN 9 | PIN 10 |
| 2 | PIN 12 | PIN 10 | 2 | PIN 10 | PIN 9 |
| 3 | PIN 27 | PIN 21 | 3 | PIN 44 | PIN 41 |
| 4 | PIN 12 | PIN 15 | 4 | PIN 3 | PIN 23 |
| 5 | PIN 13 | PIN 4 | 5 | NOT CONNECTED | |
| 6 | PIN 15 | PIN 32 | 6 | PIN 23 | PIN 3 |
| DCU 137 A | | | 7 | PIN 1 | PIN 22 |
| 1 | PIN D | PIN N | 8 | PIN 4 | PIN 31 |
| 2 | PIN 5 | PIN V | 9 | PIN 5 | PIN 24 |
| 3 | PIN CC | PIN HH | 10 | PIN 7 | PIN 32 |
| 4 | PIN A | PIN J | 11 | PIN 17 | PIN 36 |
| RACK ASSY CONV CPTR P | | | 12 | PIN 19 | PIN 24 |
| 1 | PIN 32 | PIN 33 | 13 | PIN 13 | PIN 34 |
| RPU | | | 14 | PIN 12 | PIN 33 |
| 1 | PIN 4 | PIN 12 | 15 | PIN 14 | PIN 36 |
| 2 | PIN 12 | PIN 13 | 16 | NOT CONNECTED | |
| 3 | NOT CONNECTED | | 17 | NOT CONNECTED | |
| 4 | PIN 11 | PIN 12 | 18 | PIN 9 | PIN 76 |
| 5 | PIN 13 | PIN 13 | 19 | PIN 7 | PIN 29 |
| 6 | PIN 12 | PIN 14 | 20 | PIN 11 | PIN 78 |
| | | | 21 | PIN 10 | PIN 77 |
| | | | 22 | PIN 8 | PIN 30 |
| | | | 23 | NOT CONNECTED | |
| | | | 24 | PIN 5 | PIN 6 |
| | | | 25 | PIN 21 | PIN 42 |

Figure 4.2-F  Weapon Station R Circuitry
(Sheet 4 of 4)

4.2.2    (Continued)

O    Interface with gravity bombs are the connectors shown in
     the aircraft wiring diagrams.

O    Analyses of abnormal environments are considered only one fault
     at a time.

O    Wiring faults within aircraft wiring harnesses were limited
     to those within shared cables and connectors.  Cable-to-cable
     and bundle-to-bundle wiring faults were excluded.

O    Release circuits were not included as nuclear weapon interface
     circuits during load analysis for abnormal environments.

O    Short circuits in terminals and faults internal to components
     were not considered except in the worst-case abnormal
     environment analysis for each model.

O    The abnormal environments analysis of the FB-111A escape
     capsule disconnects were limited to circuits related to
     nuclear weapons.

O    FB-111A SRAM interfaces were excluded.

## 4.2.3    IDENTITY OF CIRCUITS

The analysis used sneak circuit network trees and Air Force technical orders
to identify adjacent and interrelated circuits for fault analysis.  Network
trees and other diagrams used to analyze the circuits are included in the
individual analysis packages in section 4.2.6 of this report.

## 4.2.4    NORMAL ENVIRONMENT

Power capability of each interfacing circuit was calculated for open circuit
voltage and short circuit current at the weapon interface.

## 4.2.5    ABNORMAL ENVIRONMENTS

Each network tree was analyzed for postulated faults.  The faults are iden-
tified in the analysis package diagrams by numbered circles.  In most instances,
the worst case is a postulated short circuit at the point of lowest impedance.
Worst case current and circuit breaker trip  times have been calculated for
each interfacing circuit.

## 4.2.5.1    GROUND RULES

Resistances across relays and trip times of circuit breakers have been
selected from available data based on standard temperatures.  On the ground,
a temperature of +25C is used.  In flight, a temperature of -54C is used for
components outside the crew compartment.  Components inside the crew compart-
ment were assumed to be at +25C.  Most circuit breakers in this study are
located outside the crew compartment.  This accounts for the significantly
longer trip times of faults postulated in flight.  The following curve,
based upon Texas Instrument data, and General Dynamic Circuit Breaker
Standard C2697 were used to compute trip times.



TIME IN SECONDS
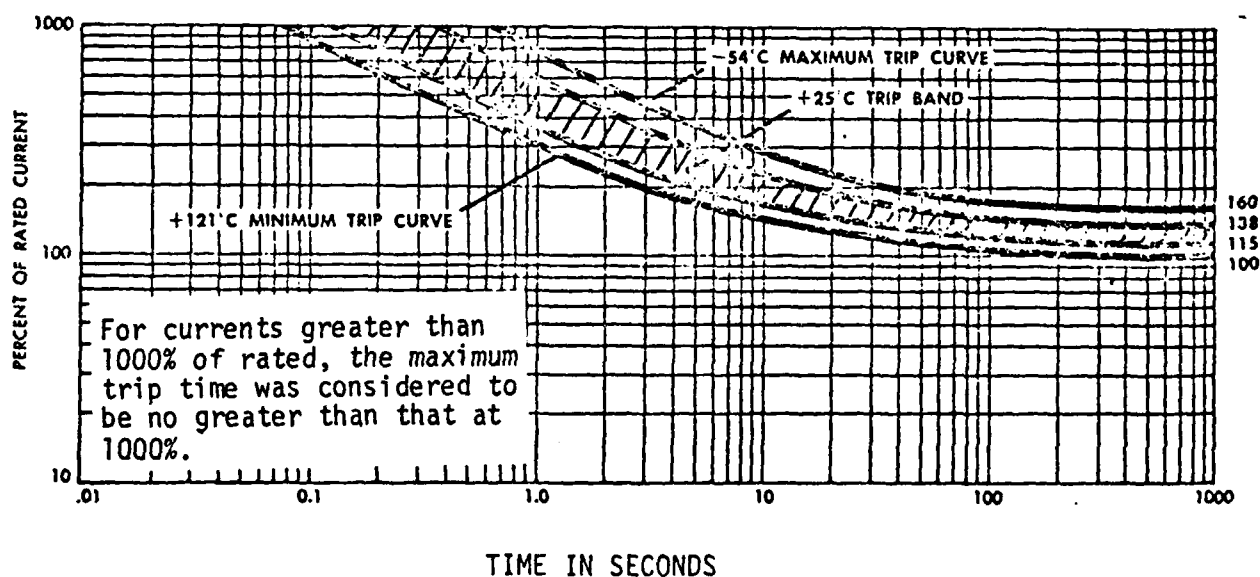
CB TRIP TIME VS CURRENT PROFILE

## 4.2.5.1   (Continued)

Circuits fed by TR (Transformer/Rectifier) power were assumed to carry 28 volts direct current. There are some faults to circuits carrying either 115 volts or 28 volts alternating current. In all cases, power profiles were found to be step functions, lasting until the circuit breaker trips. No current was found that was high enough to weld the circuit breaker closed, however some fault currents would be so low (mA) that they would remain indefinitely on cirucits protected against much higher currents.

## 4.2.6   CIRCUIT ANALYSIS PACKAGES

Normal and fault analyses are documented in individual packages for the circuit groups. The following analysis packages cover all of the gravity weapon interface circuits at stations 3 and R:

| | | |
|---|---|---|
| 4.2.6.1 | Pin P | Permissive Action Link Ground |
| 4.2.6.2 | Pins A,H,J,Y,X,Z, d, e, f | Arm/Safe Inputs, Burst Options, Plus Weapon Drop Config. |
| 4.2.6.3 | Pins L,N, a, c | Nuclear Weapons Control and SRAM Circuitry |
| 4.2.6.4 | Pin b | Master Power Distribution |
| 4.2.6.5 | Pins C,G,R | Monitor & Release Plus Option Selector & Monitor |
| 4.2.6.6 | Pins S,V,W | Station Select |

Note: Power Profiles - In all cases the short circuit current was found to be either much less than the source circuit breaker ratings or much greater than the ratings. Where the current was much less than the rating the current will remain constant until the source is removed. Where the current is much greater, the current will remain constant until the circuit breaker trips. A typical profile of this case is shown below.



4-154
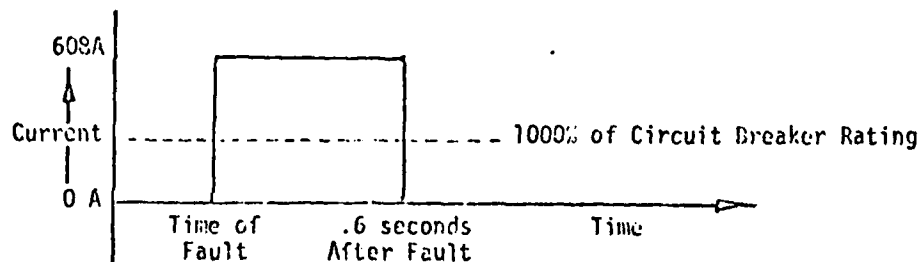
4.2.6.1   Circuit Analysis Package, Weapon Interfaces Pin P of AMAC
          SPU-3 and -R (Weapon Station 3 Pylon and Weapon Station R Bay)

These interfaces are shown in Figure 4.2-D, which is a copy of Figure 1-8
from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the circuitry to the pivot
pylon weapon station AMAC SPU interfaces and Figure 4.2-F which is a
copy of Figure 1-10 from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the
circuitry to L and R-Bay AMAC SPU interfaces.  A generalized schematic
highlighting pin P circuitry is attached below.  Maximum current available
to Pin P in a normal environment is 48 mA (direct current).  Worst-case
current at 28VDC in an abnormal (faulted) environment would be 608 amps
for weapon station 3 and 1333 amps for weapon station R.  Worst case fault
current at 115VAC would be 451 amps for a weapon station 3.  No faulted AC
current has been identified for weapon station R.



AMAC SPU INTERFACE
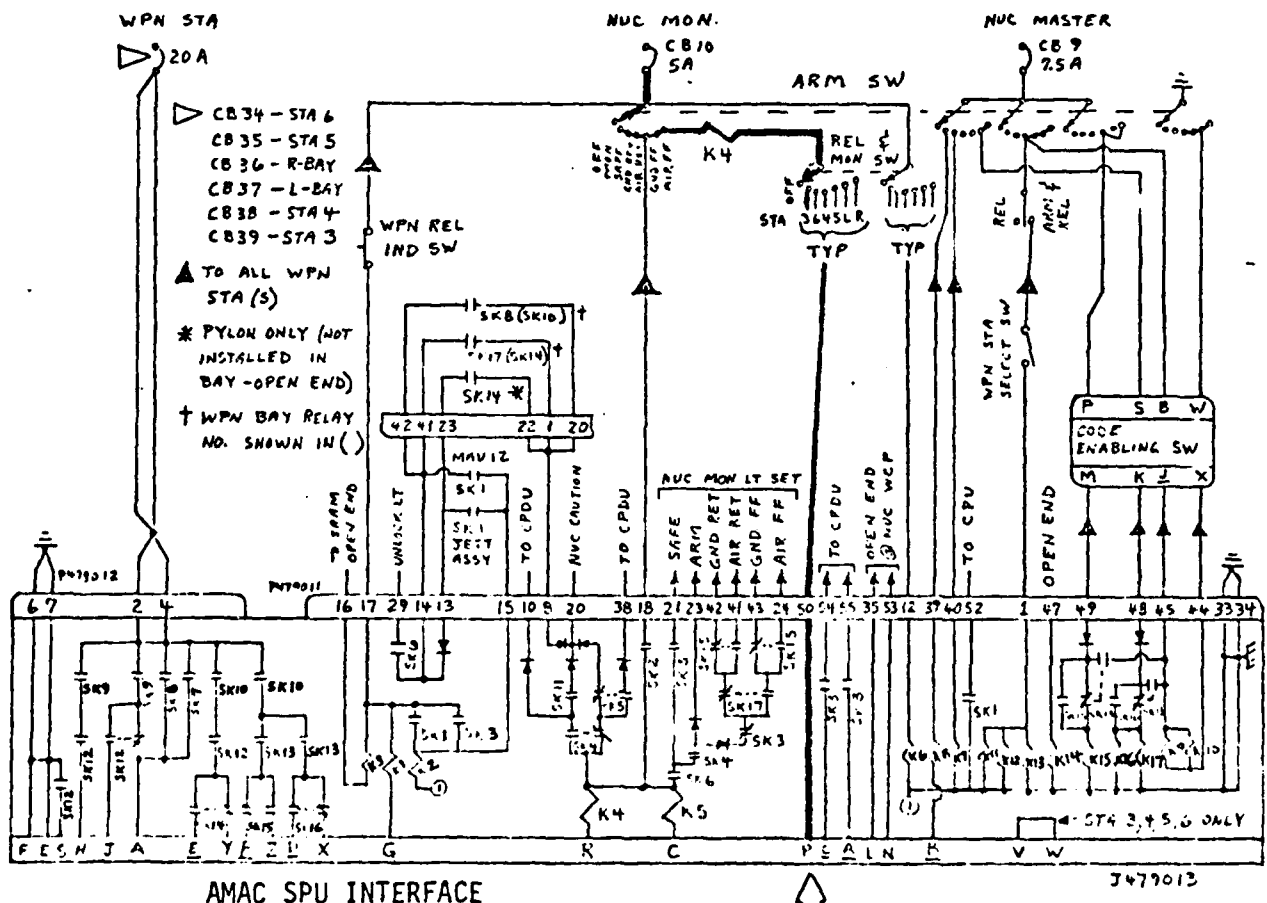
4.2.6.1

4.2.6.1    (Continued)

a.    Normal Power and Loads Analysis

Reference Figure 4.2-1 Network Tree 334 and Monitor Relay Technical Data.
From examination of network tree and the Monitor Relay Technical Data;
J479013-P for any weapon station

$$V_{OC} = 28VDC; \quad I_{SC} = \frac{28}{579} = \underline{48} \text{ mA}$$

b.    Fault Analysis

Reference Figure 4.2-1 Network Tree 334, Figure 4.2-2 Fault Diagram
Weapon Station 3 and Figure 4.2-3 Fault Diagram Weapon Station R.    The
following faults were postulated:

①    Wiring Harness 247W2 Damaged

Wires to pin P shorted to 28VDC.  See Table 4.2-1 for
voltage sources.

②    Nuclear Weapon Control Panel Damaged

Wires to pin P shorted to 28VDC.  See Table 4.2-1 for
voltage sources.

③    Wiring Harness 247W3, 247W14, Wing-Fuselage Disconnect 301J10
or Wing Pylon 3 Disconnect J600-9 Damaged

Wires to pin P shorted to 28VDC.  See Table 4.2-1 for voltage sources.

④    Pylon 3 Wiring Harness 351W1, 351W2, 354W1, 354W2, or Wing Pylon
Disconnect J613 Damaged (Worst Case -115VAC

Wires to pin P shorted to 28VDC or 115V 400H$_z$.  See Table 4.2-1 for
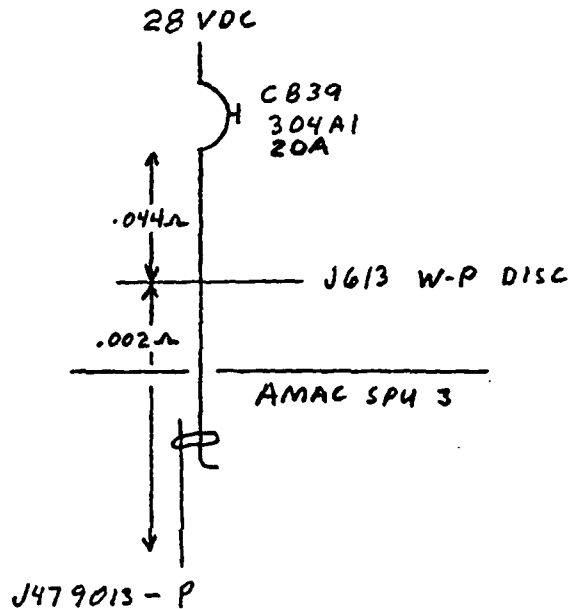voltage sources.

⑤    AMAC SPU Damaged (Worst Case - 28VDC

Wires to pin P shorted to 28VDC.  See Table 4.2-1 for voltage sources.

4.2.6.1   (Continued)

c.   Worst Case Path for Weapon Station 3 at 28VDC

Reference path (5) from paragraph b.



Total resistance at path = .046 $\Omega$

$V_{OC}$ = 28VDC
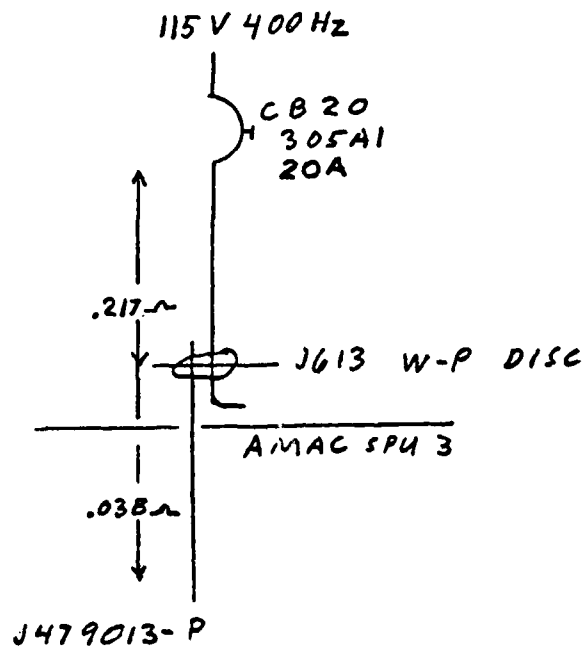
$I_{SC} = \dfrac{28}{.046}$   = 608 A

Time = Less than .6 seconds at -54°C for circuit breaker to open. On ground alert at 25°C the time to open would be less than .35 seconds.

4.2.6.1 (Continued)

d. Worst Case Path for Weapon Station 3 at 115V 400H$_z$

Reference path ④ from paragraph b.



Total resistance of path .255 $\Omega$

$V_{OC}$ = 115V 400H$_z$
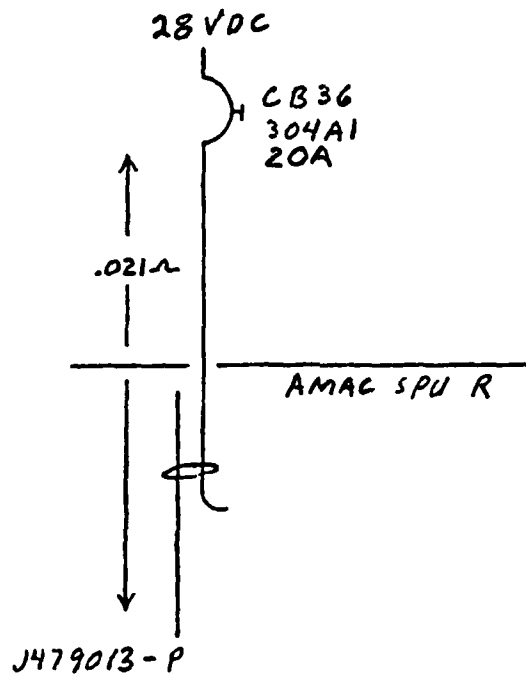
$I_{SC} = \dfrac{115}{.255}$ = 451 A

Time ≈ Less than .6 seconds at -54°C for circuit breaker to open
On ground alert at 25°C the time to open would be less
than .35 seconds.

4.2.6.1    (Continued)

e.    <u>Worst Case Path for Weapon Station R</u>

Reference path ⑤ from paragraph b.

28 VDC

CB 36
304A1
20A

.021 Ω

AMAC SPU R

J479013 - P
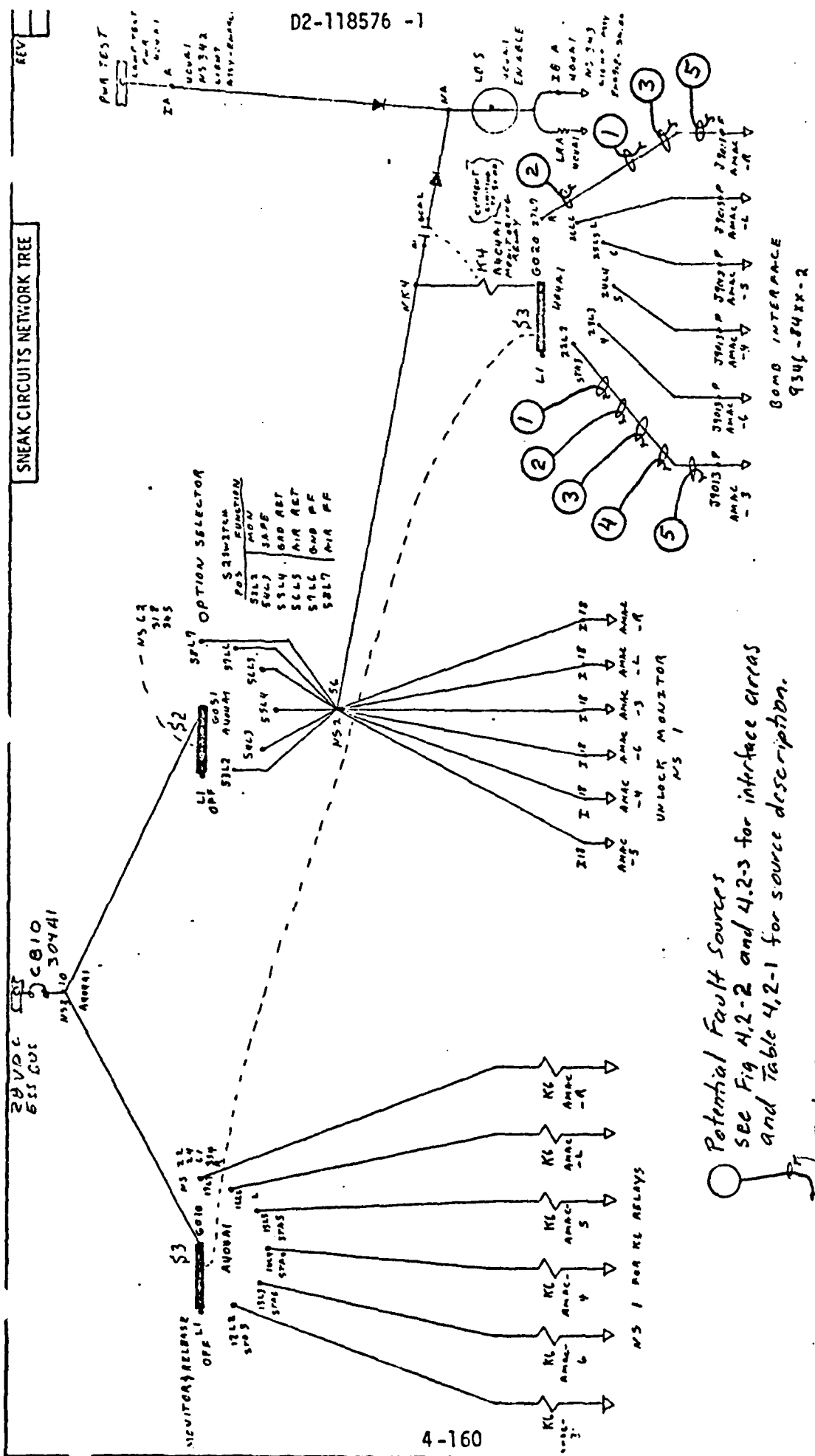
Total resistance of path .021 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.021}$ = <u>1333</u> A

Time = Less than <u>.6</u> seconds at -54°C for circuit breaker to open.
On ground alert at 25°C the time to open would be less than
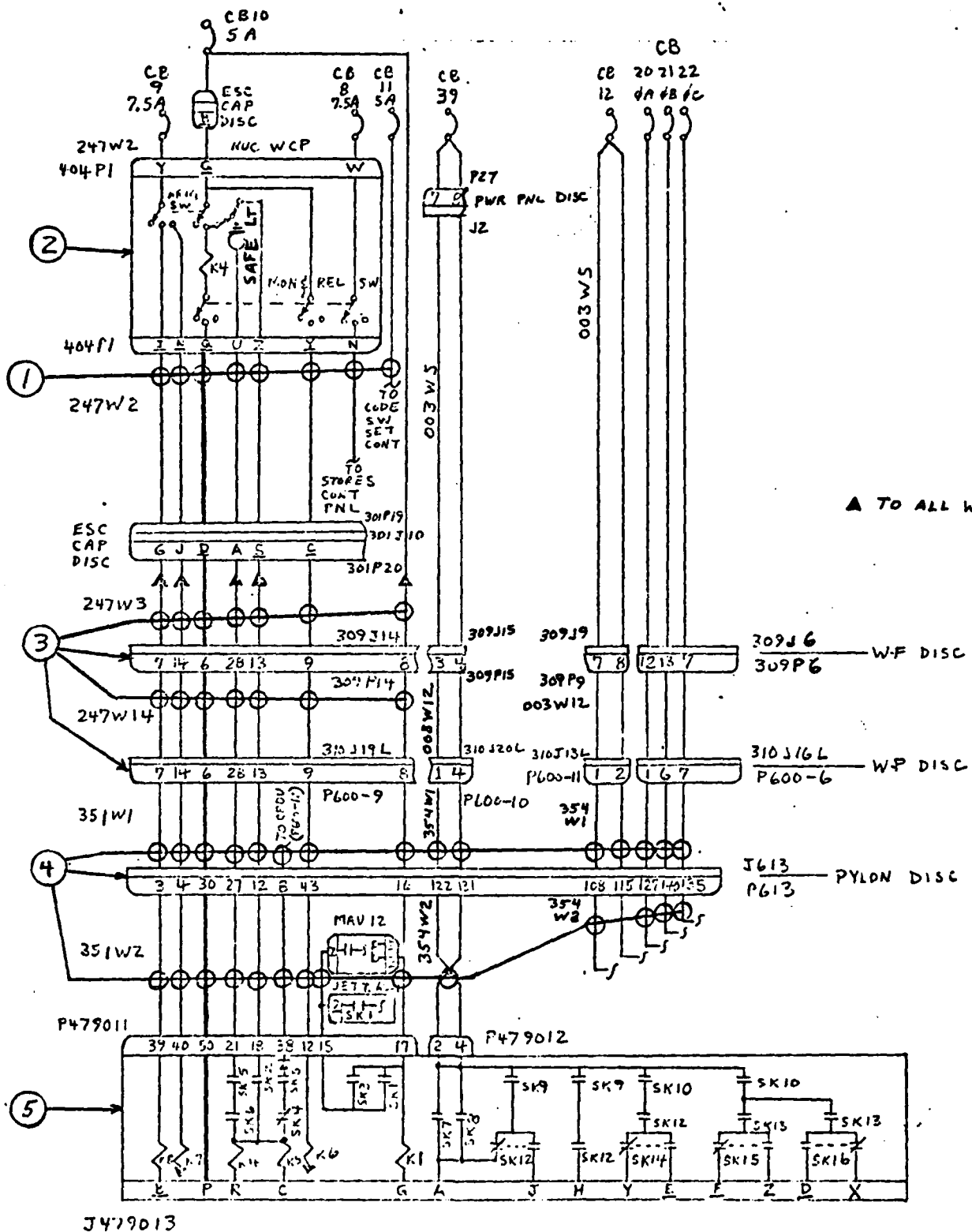.35 seconds.

Figure 4.2-1   NETWORK TREE 334

Figure 4.2-2   FAULT DIAGRAM WEAPON STATION 3
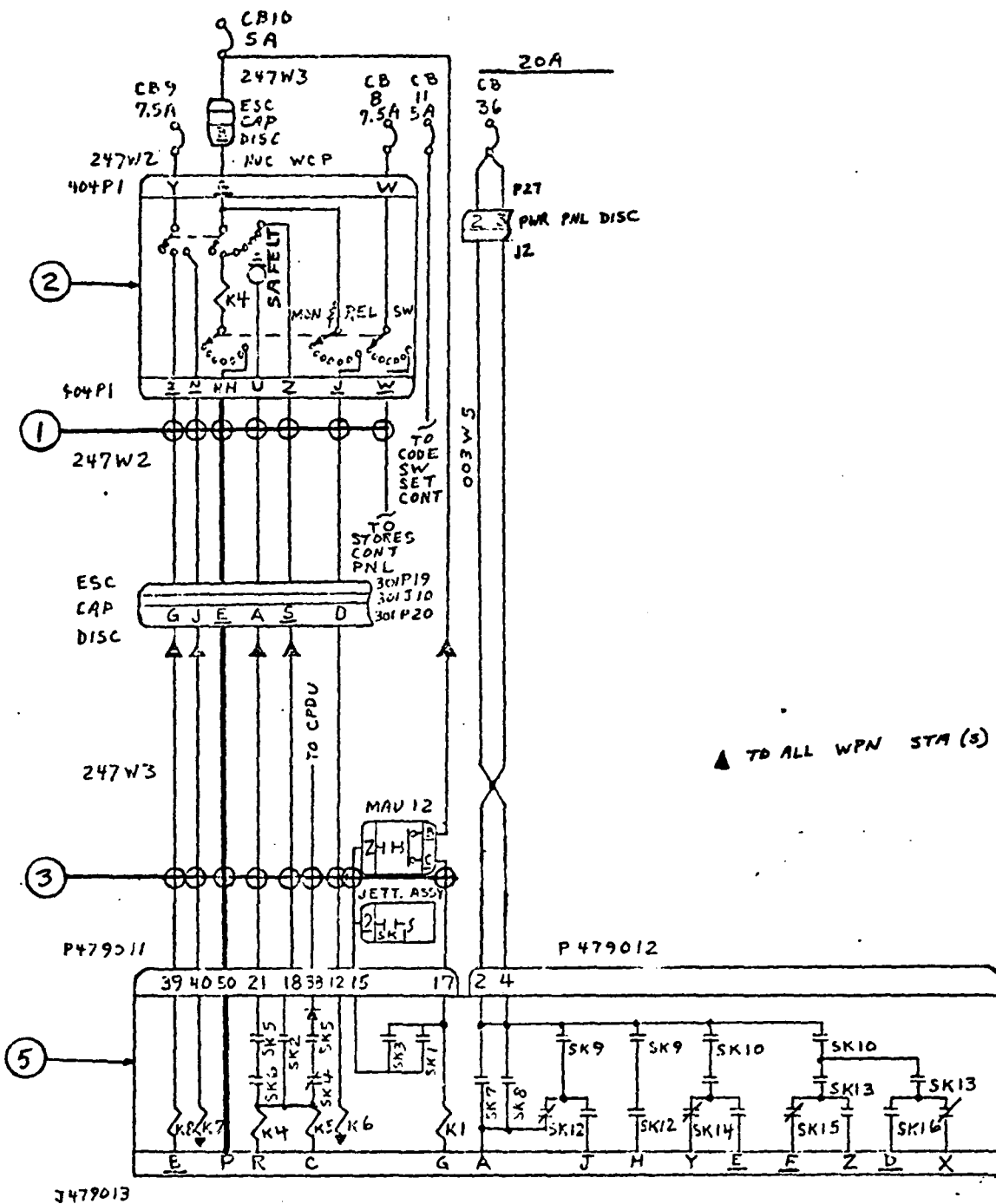
Figure 4.2-3  FAULT DIAGRAM WEAPON STATION R

4.2.6.1   (Continued)

TABLE 4.2-1

POTENTIAL FAULT POWER SOURCES

| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| ① | CB8 (7.5A) UNIT 314A1<br>CB9 (7.5A) UNIT 314A1<br>CB11 (5A) UNIT 314A1<br>CB10 (5A) UNIT 304A1 | 28VDC CREW STA ESS BUS<br>28VDC CREW STA ESS BUS<br>28VDC CREW STA ESS BUS<br>28VDC ESS BUS |
| ② | CB8 (7.5A) UNIT 314A1<br>CB9 (7.5A) UNIT 314A1<br>CB10 (5A) UNIT 304A1 | 28VDC CREW STA ESS BUS<br>28VDC CREW STA ESS BUS<br>28VDC ESS BUS |
| ③ | CB9 (7.5A) UNIT 314A1<br>CB10 (5A) UNIT 304A1 | 28VDC CREW STA ESS BUS<br>28VDC ESS BUS |
| ④ | CB9 (7.5A) UNIT 314A1<br>CB10 (5A) UNIT 304A1<br><br>CB20 (20A) UNIT 305A1<br>CB21 (20A) UNIT 305A1<br>CB22 (20A) UNIT 305A1<br>CB12 (35A) UNIT 315A1<br>CB39 (20A) UNIT 304A1 | 28VDC CREW STA ESS BUS<br>28VDC ESS BUS<br><br>115VAC 400Hz L MAIN BUS<br>115VAC 400Hz L MAIN BUS<br>115VAC 400Hz L MAIN BUS<br>28VDC MAIN BUS<br>28VDC ESS BUS |
| ⑤ | CB9 (7.5A) UNIT 314A1<br>CB10 (5A) UNIT 304A1<br>**CB39 (20A) UNIT 304A1<br>*CB36 (20A) UNIT 304A1 | 28VDC CREW STA ESS BUS<br>28VDC ESS BUS<br>28VDC ESS BUS<br>28VDC ESS BUS |

*Station R only

**Station 3 only

4-163

AMAC SPU PINS

A, H, J, Y, X, Z, d, e, & f

CIRCUIT ANALYSIS PACKAGE

4.2.6.2 Circuit Analysis Package, Weapon Interface Pins A, H, J, Y, X, Z, d, e, f of AMAC SPU-3 and -R. (Weapon Station 3 Pylon and Weapon Station R Bay)

These interfaces are shown in Figure 4.2-D, which is a copy of Figure 1-8 from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the circuitry to the pivot pylon weapon station AMAC SPU interfaces and Figure 4.2-F which is a copy of Figure 1-10 from T.O. IF-111(B)A-2-11-1 (Change 2) showing the circuitry to L and R-Bay AMAC SPU interfaces. A simplified general schematic is attached below. Maximum current available to pin A in a normal environment is 608 amps (direct current) at Weapon Station 3 and 1333 amps at Weapon Station R. Maximum Current available to pins H, J, Y, X, Z, d, e and f in a normal environment for weapons station 3 and R is 0 amps. Worst case current at 28VDC in an abnormal (faulted) environment would be 608 amps at Weapon Station 3 and 1333 amps at Weapon Station R for all the subject interface pins. Worst case fault current at 115VAC would be 1983 amps at pin A for Weapon Station 3 and 3286 amps at pin A for Weapon Station R. No faulted AC current has been identified for pins H, J, Y, X, Z, d, e and f of Weapon Station 3 or Weapon Station R.



4.2.6.2    4-164    AMAC SPU INTERFACE
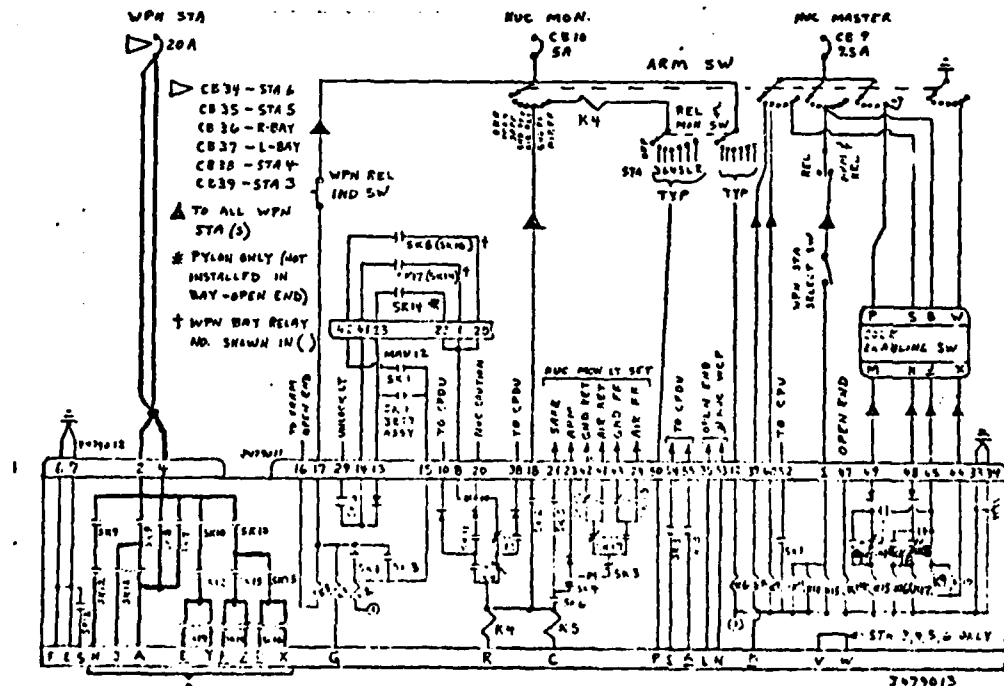
4.2.6.2    (Continued)

a.    Normal Power and Load Analysis

Reference Figure 4.2-4 Network Tree 365 and Figure 4.2-5 Network Tree 300. Relays K7 and K8 in the AMAC SPU can be energized by selecting Monitor and Safe options respectively on the Monitor and Control switch on the Nuclear Weapons Control Panel.  From examination of the network trees: J479013 A weapon station 3

$V_{OC} = 28VDC$

$I_{SC} = \dfrac{28}{.046 \, \Omega}* = \underline{608} \ A$

*Wire resistance from CB to weapon interface

J479013-A weapon station R

$V_{OC} = 28VDC$

$I_{SC} = \dfrac{28V}{.021 \, \Omega}* = \underline{1333A}$

*Wire resistance from CB to weapon interface

Actual current is assumed to be something less than 20 amps, the rating of the 28VDC circuit breaker.

J479013-H, J, X, Y, Z, d, e, f for all weapon stations

$V_{OC} = 0V$

$I_{SC} = \underline{0A}$

b.    Fault Analysis

Reference Figure 4.2-4 Network Tree 365, Figure 4.2-5 Network Tree 300, Figure 4.2-6 Fault Diagram Weapon Station 3 and Figure 4.2-7 Fault Diagram Weapon Station R.  The following postulated faults were analyzed.

(1)    Wiring Harness 003W5 Damaged

Wires to pin A (assuming K7 or K8 in the AMAC SPU are energized) shorted to 28VDC or 115V 400 $H_z$.  See Table 4.2-2 for voltage sources.

(2)    Wiring Harness 003W14 Damaged

Wires to pin A (assuming either K7 or K8 in the AMAC SPU energized) shorted to 28VDC or 115V 400$H_z$.  See Table 4.2-2 for voltage sources.

4.2.6.2b (Continued)

③ Connector 309J15 Damaged

Wires to pin A (assuming either K7 or K8 energized in the AMAC SPU) shorted to 28VDC from CB38 unit 304A1. See Table 4.2-2 for voltage source.

④ Pylon 3 Wiring Harness 351W1, 351W2, 354W1, 354W2 or Wing Pylon Disconnect J613 Damaged

Wires to pin A (assuming either K7 or K8 energized in the AMAC SPU) shorted to 28VDC or 115V 400H$_z$. See Table 4.2-2 for voltage sources.

⑤ AMAC SPU Damaged

Wires to pins A, H, J, Y, X, Z, d, e, f shorted to 28VDC. See Table 4.2-2 for voltage sources.

⑥ Power Panel Disconnect P27 Damaged

Wires to pin A (assuming either K7 or K8 energized in the AMAC SPU) shorted to 28VDC. See Table 4.2-2 for voltage sources.

4.2.6.2    (Continued)

c.    Worst Case Path for Weapon Station 3 at 28VDC

Reference path ⑤ from paragraph b.

28 VDC

CB39
304 AI
20A

.044 Ω

J613 W-P DISC

AMAC SPU 3

.002 Ω
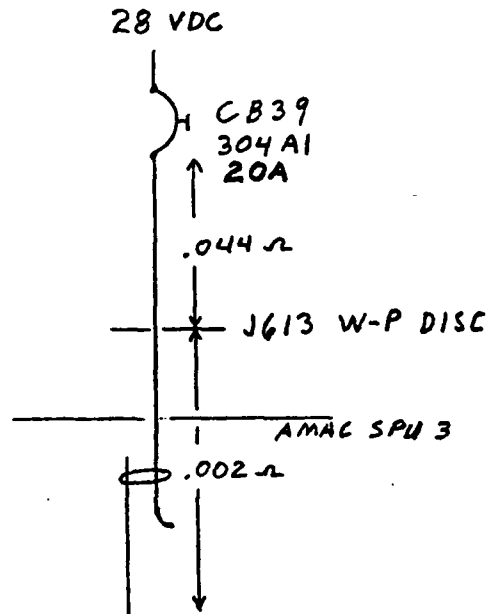
J479013-A   (Typical for H, J, X, Y, Z, d, e, f)

Total resistance at path = .046 Ω

$V_{OC}$ =   28VDC

$I_{SC}$ =   $\dfrac{28}{.046}$   =   608A

Time = Less than .6 seconds at -54°C for circuit breaker to open.
On ground alert at 25°C the time to open would be less than
.35 seconds.

4.2.6.2    (Continued)

d.    <u>Worst Case Path for Weapon Station 3 at 115V 400 H<sub>z</sub></u>

Reference path ① from paragraph b.

115V  400 Hz

CB20
305A1
20A

.058 Ω

AMAC SPU 3

SK8    SK7

J479013-A

Total resistance of path = .058 Ω

$V_{OC}$ = 115V 400 H$_z$

$I_{SC}$ = $\frac{115}{.058}$ = $\underline{1983}$ A

Time = Less than <u>.6</u> seconds at -54°C for circuit breaker to open.
On ground alert at 25°C the time to open would be less than
.35 seconds.

4.2.6.2    (Continued)

e.    <u>Worst Case Path for Weapon Station R at 28VDC</u>

Reference path⑤from paragraph b.

28VDC

CB36
304 A1
20A

.021Ω

AMAC SPU R

J479013-A (Typical for H, J, X, Y, Z, d, e, f)

Total resistance of path = .021Ω

$V_{OC}$ = 28VDC

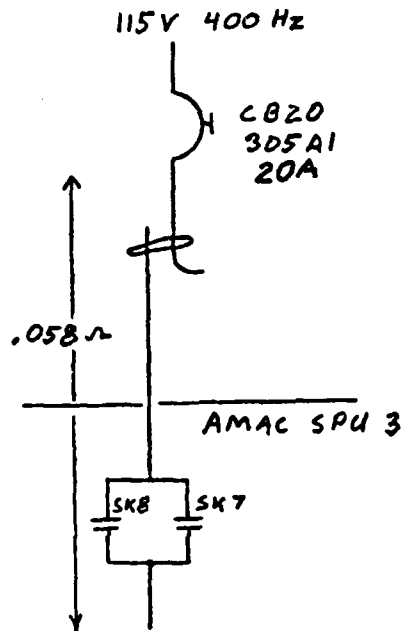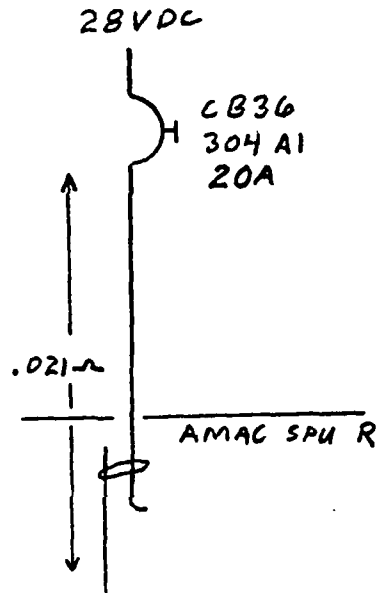$I_{SC}$ = $\frac{28}{.021}$ = <u>1333</u> A

Time = Less than <u>.6</u> seconds at -54°C for circuit breaker to open.
On ground alert at 25°C the time to open would be less than
.35 seconds.

4.2.6.2    (Continued)

f.    <u>Worst Case Path for Weapon Station R at 115V 400 H<sub>z</sub></u>

Reference path①from paragraph b.



J479013-A
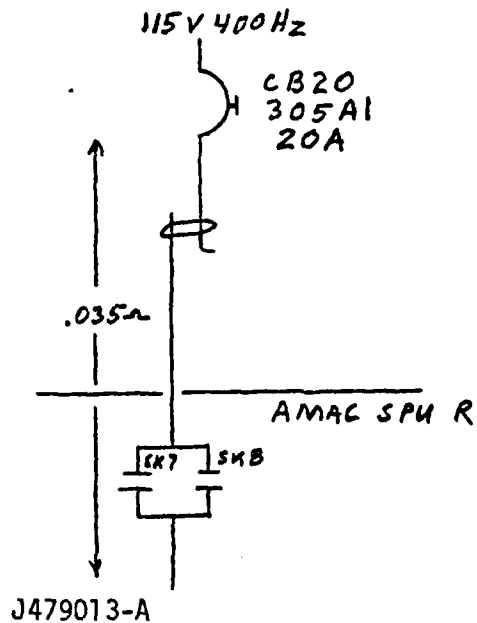
Total resistance at path = .035 $\Omega$

$V_{OC}$ = 115V 400 H$_z$

$I_{SC} = \dfrac{115}{.035} = \underline{3286}$ A

Time = Less than <u>.6</u> seconds at -54°C for circuit breaker to open.
On ground alert at 25°C the time to open would be less than
.35 seconds.

SNEAK CIRCUITS NETWORK TREE

Notes:
1 REF DES IS AMAC-3 UNLESS OTHERWISE SHOWN
2. INCLUDES NODAL SET 303

Potential Fault Sources
See Fig 4.2-6 for interface areas
and Table 4.2-2 for source description

Interface point for adjacent
circuitry

| PROJECT | TITLE | | | |
|---|---|---|---|---|
| FB-111A | AMAC·3 | | | |
| QC | DATE | ANALYST'S | DATE | NODAL SET |
| | | | | 365 |

THE BOEING AEROSPACE COMPANY · HOUSTON, TEXAS

Figure 4.2-4   NETWORK TREE 365

Figure 4.2-5  NETWORK TREE 300

Figure 4.2-6   FAULT DIAGRAM WEAPON STATION 3

Figure 4.2-7   FAULT DIAGRAM WEAPON STATION R

4.2.6.2   (Continued)

TABLE 4.2-2

POTENTIAL FAULT POWER SOURCES

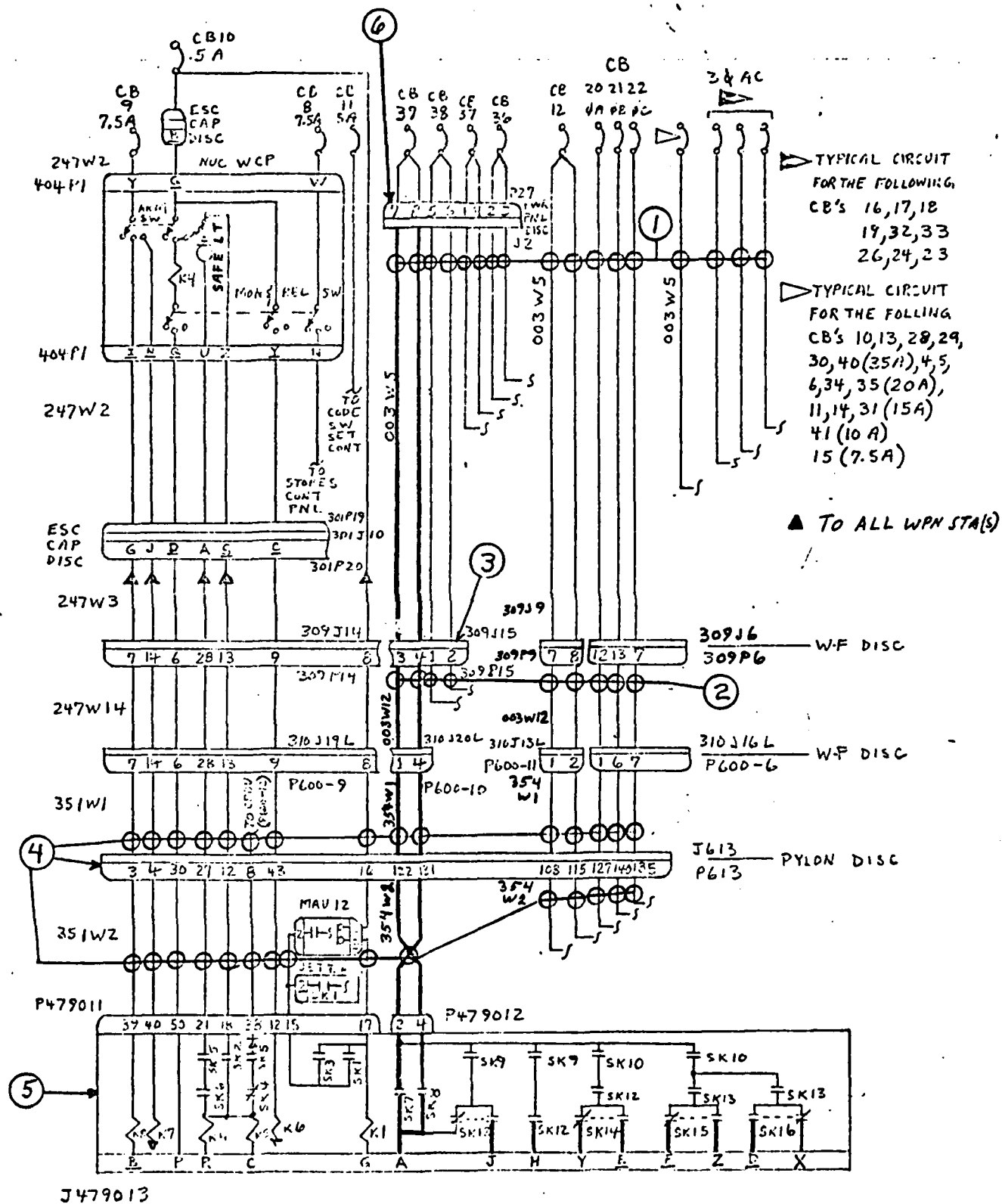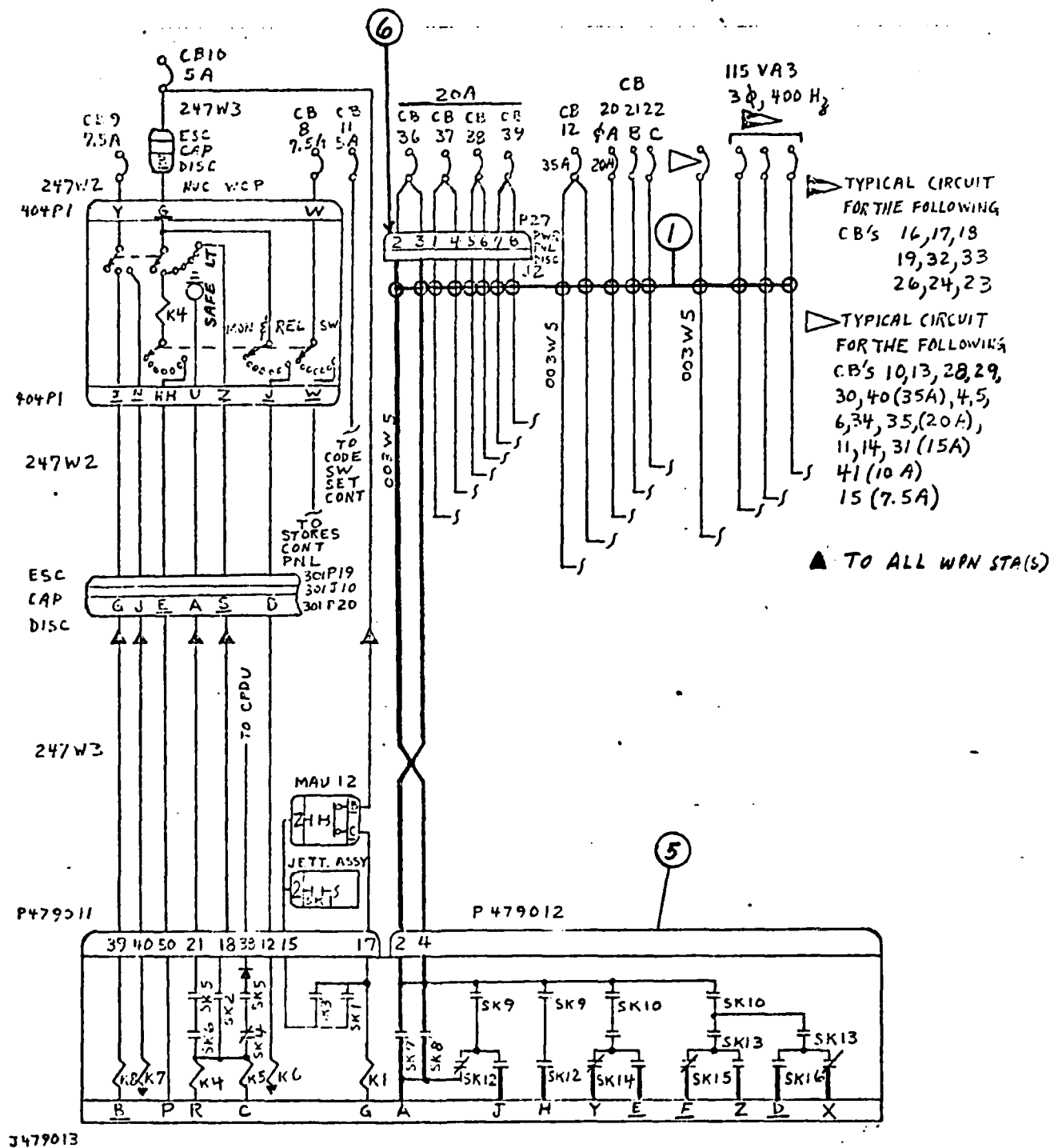| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| | CB16 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB17 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB18 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB19 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB20 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB21 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB22 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB23 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB24 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB26 (20A) UNIT 305A1 | 115V 400Hz R MAIN BUS |
| | CB32 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB33 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB11 (15A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB14 (15A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB15 (15A) UNIT 304A1 | 28VDC ESS BUS |
| ① | CB28 (15A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB31 (15A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB10 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB12 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB13 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB29 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB30 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB40 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB4 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB5 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB34 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | **CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB37 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | *CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB12 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB41 (10A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB19 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB20 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| ② | CB21 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB22 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB32 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |
| | CB33 (20A) UNIT 305A1 | 115V 400Hz L MAIN BUS |

4.2.6.2    (Continued)

TABLE 4.2-2 (Continued)

POTENTIAL FAULT POWER SOURCES

| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| ③ | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ④ | CB9 (7.5A) UNIT | 28VDC CREW STA ESS BUS |
|  | CB10 (5A) UNIT | 28VDC ESS BUS |
|  | CB12 (35A) UNIT | 28VDC MAIN BUS |
|  | CB20 (20A) UNIT | 115V 400Hz ØA L MAIN BUS |
|  | CB21 (20A) UNIT | 115V 400Hz ØB L MAIN BUS |
|  | CB22 (20A) UNIT | 115V 400Hz ØC L MAIN BUS |
| ⑤ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
|  | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
|  | *CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
|  | **CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ⑥ | **CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
|  | CB37 (20A) UNIT 304A1 | 28VDC ESS BUS |
|  | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
|  | *CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |

\*    STATION R ONLY

\*\*    STATION 3 ONLY

AMAC SPU PINS

L, N, a, c

CIRCUIT ANALYSIS PACKAGE

4.2.6.3   Circuit Analysis Package, Weapon Interface Pins L, N, a, c of
          AMAC SPU-3 and -R (Weapon Station 3 Pylon and Weapon Station R Bay)

These interfaces are shown in Figures 4.2-8 through 4.2-10 Sneak Circuits
Network Tree 35C, T.O. 1F-111(B)A-2-14 and T.O. 11N-T5036-2. Maximum
current and voltage to all of these interfaces in a normal environment is
<u>0</u>. This is because the wiring to pins L and N dead ends at the Nuclear
Weapons Control Panel and the wiring to pins a and c is connected to SRAM
circuitry and is not used for gravity weapons. Worst case current, at
28VDC in an abnormal faulted environment and assuming a ground at the
weapon interface is <u>608</u> amps for weapon station 3 and <u>1333</u> amps for weapon
station R   Worst case fault current at 115VAC would be <u>451</u> amps at weapon
station 3 , .is L and N and <u>215</u> amps at weapon station R pins L and N.



AMAC SPU INTERFACE
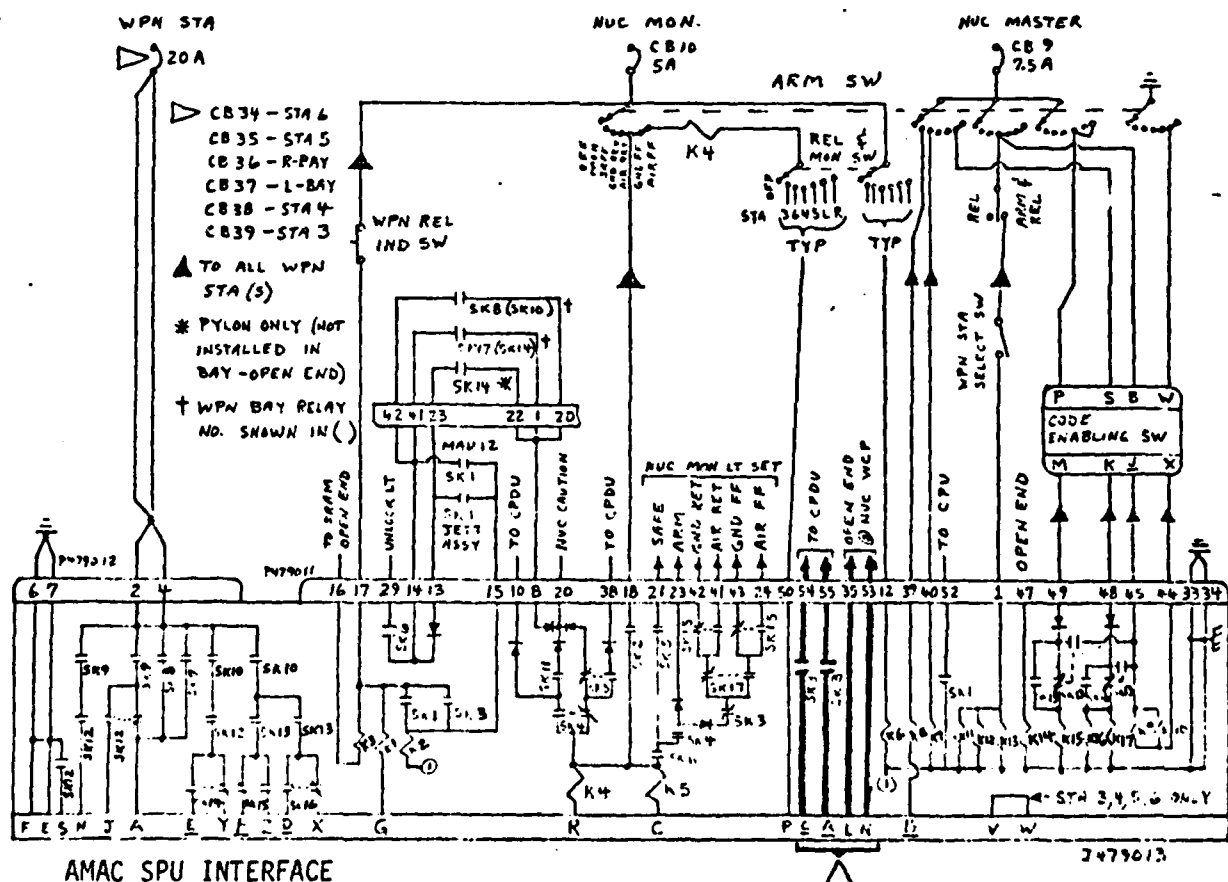
4.2.6.3

4.2.6.3   (Continued)

a.   Normal Power and Load Analysis

Reference Figures 4.2-8, 4.2-9, 4.2-10, Network Trees 352, 354, 355, 356.

From examination of network trees in Figure 4.2-10 for pins L and N at any weapon station

$$V_{OC} = \underline{0} \text{ V}$$
$$I_{SC} = \underline{0} \text{ A}$$

From examination of network trees in Figures 4.2-8 and 4.2-9 for pins a and c at any weapon station.

$$V_{OC} = \underline{0} \text{ V}$$
$$I_{SC} = \underline{0} \text{ A}$$

Since relay K3 can only be energized if a  SRAM is installed.

b.   Fault Analysis

Reference Figures 4.2-8, 4.2-9 and 4.2-10, Network Trees 352, 354, 355, and 356 and Figure 4.2-11 Fault Diagram Weapon Station 3 and Figure 4.2-12 Fault Diagram Weapon Station R.

Since the wiring to pins L, N, a, and c are bussed to all nuclear weapons stations, any 28VDC or 115V 400 Hz power that might fault into these circuits for any weapon station will propagate to all weapon stations.

(1)   Wiring Harness 247 W2 Damaged

Wires to pin L or N shorted to 28VDC.  See Table 4.2-3 for voltage sources.

(2)   Wiring Harness 247 W3 Damaged

Wires to pin L or N shorted to 28VDC.  See Table 4.2-3 for voltage sources.

4.2.6.3   (Continued)

b.   Fault Analysis (Continued)

(3)   Wiring Harness 247 W14, 247 W15, Wing Fuselage

Disconnect 308J13, 308J14, 309J13, 309J14 or Pylon 3, 4, 5, or
6 Wing Pylon Disconnect Damaged.

Wires to pin L or N shorted to 28VDC.  See Table 4.2-3 for
voltage sources.

(4)   Pylon 3, 4, 5, 6 Wiring Harness 351 W1, 351 W2, 354 W1
354 W2 or Pylon Disconnect J613 Damaged

Wires to pin L or N shorted to 28VDC or 115V 400Hz.  See Table
4.2-3 for voltage sources.

(5)   AMAC SPU Damaged

Wires to pin L, N, a, c shorted to 28VDC.  See Table 4.2-3 for
voltage sources.

4.2.6.3   (Continued)

c.   <u>Worst Case Path for Weapon Station 3 at 28VDC</u>

Reference path⑤from paragraph b.

**28 VDC**

CB 39
304 Al
20A

.044Ω

W-P DISC

AMAC SPU-3

.002Ω
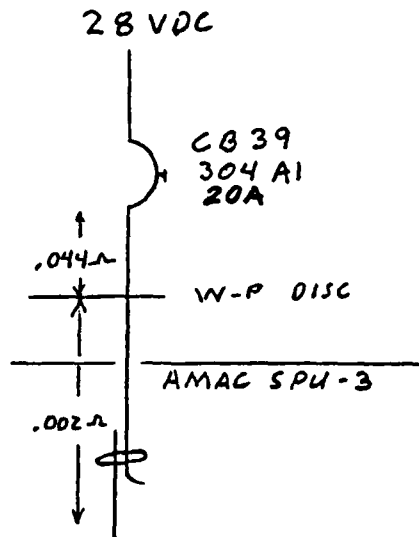
J479013/L (Typical for N, a, c)

Total resistance of path = .046 ohms

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.046} = \underline{608}$ amps

Time = Less than .6 seconds at $-54^{O}C$ for circuit breaker to open.
       On ground alert at $25^{O}C$ the time to open would be less than
       .35 seconds.

4.2.6.3    (Continued)

d.    <u>Worst Case Path for Weapon Station 3 at 115V 400Hz Pins L and N</u>
Reference path④ from paragraph b.



J479013/L (Typical for N)

Total resistance of path = .255 ohms

$$V_{OC} = 115V\ 400Hz$$

$$I_{SC} = \frac{115}{.255} = \underline{451}\ \text{amps}$$

Time = Less than .6 seconds at $-54^O$C for circuit breaker to
open.  On ground alert at $25^O$C the time to open would
be less than .35 seconds.

4.2.6.3    (Continued)

e.    Worst Case Path for Weapon Station R at 28VDC

Reference path ⑤ from paragraph b.

28VDC

CB 36
304 A1
20A

.021 Ω

AMAC SPU R

J479013/L (Typical for N, a, c)

Total resistance of path = .021 ohms
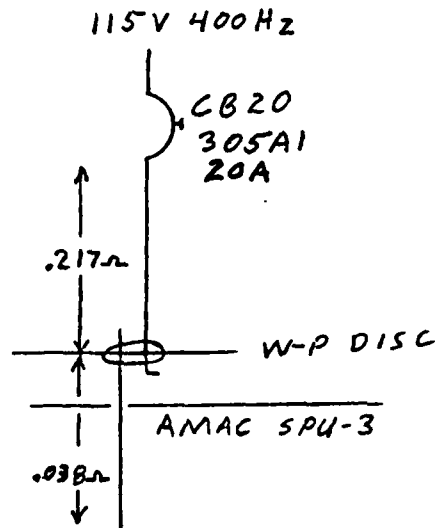
$V_{OC}$ = 28VDC

$I_{SC} = \frac{28}{.021} = \underline{1333}$ amps

Time = Less than .6 seconds at -54°C for the circuit breaker to open. On ground alert at 25°C the time to open would be less than .35 seconds.

4.2.6.3   (Continued)

f.   <u>Worst Case Path for Weapon Station R for 115V, 400Hz at Pins L and N</u>

Reference path④from paragraph b.



115 V 400 HZ

CB 16
305A1
20A

← TO ALL WEAPON STATIONS

.188↗

.347↗

← W-P DISC

AMAC SPU-5

AMAC SPU R

J479013/L

J479013/L
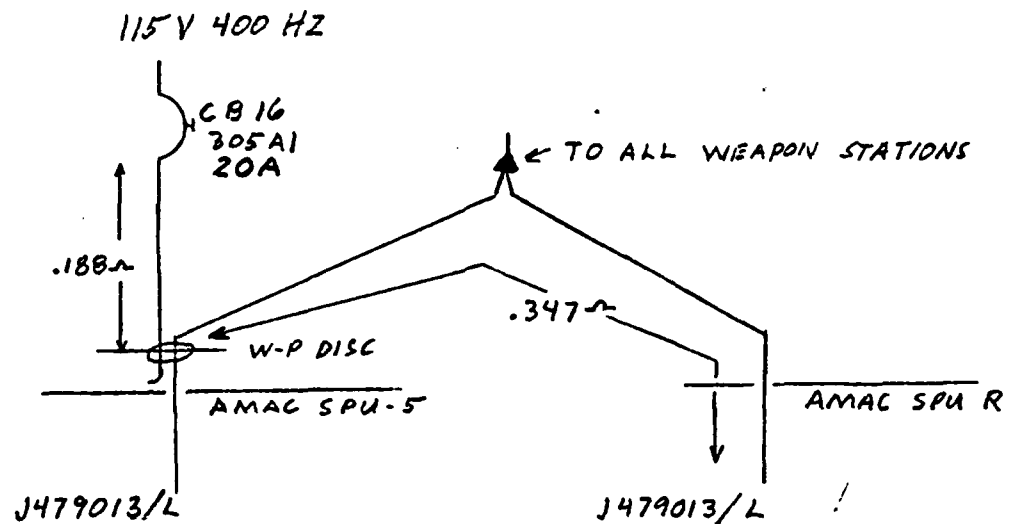
Typical for N

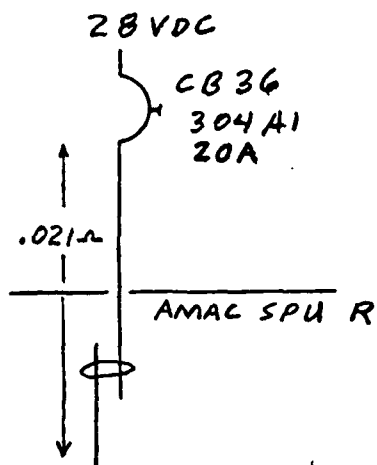Total resistance of path = .535 ohms

$V_{OC}$ = 115V 400Hz

$I_{SC} = \dfrac{115}{.535} = \underline{215}$ amps

Time = Less than .6 seconds at -54°C for circuit breaker to
       open.  On ground alert at 25°C the time to open would
       be less than .35 seconds.

FIGURE 4.2-8.  NETWORK TREE 352

4-184

HOU-705    The **BOEING** AEROSPACE COMPANY - HOUSTON, TEXAS

| QC | DATE | ANALYST | DATE | NODAL SET | 352 |
|----|------|---------|------|-----------|-----|
|    |      |         | 4-16-75 |        | |

| PROJECT | TITLE |
|---------|-------|
| FB111A | SAF Class III Cmd - UP |

Potential Fault Sources
See Fig 4.2-11 and 4.2-12 for interface areas
and Table 4.2-3 for source description.

Interface point for adjacent
circuitry

▷1 Command From Central Processor & Distributor Unit:
"SAF Class III Cmd - up".

▷2 29013's are at SRAM interface

▷3 For all K3's, ref. NS.1

29013/-A (AMAC-5)  K3
29013/-A (AMAC-6)  K3
29013/-A (AMAC-3)  K3
29013/-A (AMAC-4)  K3
29013/-A (AMAC-2)  K3
29013/-A (AMAC-1)  K3

▷2
▷3

⑤

TB157-10

(28PA2) 515/2 (CPDU)

Pwr/Cmd
▷1

SNEAK CIRCUITS NETWORK TREE          REV

SNEAK CIRCUITS NETWORK TREE — REV

See Fig 4.2-8 for symbol explanation

① N.C. J1/J (404A1)
TB15B-4

J9013/L (AMAC-L)  J9013/L (AMAC-R)  J9013/L (AMAC-3)  J9013/L (AMAC-4)  J9013/L (AMAC-5)  J9013/L (AMAC-6)

⑤ ②    ② ③ ④ ⑤

▷ NOT CONNECTED IN 404A1, NUCLEAR WEAPON CONTROL PANEL

| PROJECT | TITLE | | | |
|---|---|---|---|---|
| FB111A | OPEN END — NO FUNCTION | | | |
| QC | DATE | ANALYST | DATE 9-16-75 | NODAL SET 355 |

SNEAK CIRCUITS NETWORK TREE — REV

See Fig 4.2-8 for symbol explanation

① N.C. J1/K (404A1)
TB15B-3

J9013/N (AMAC-L)  J9013/N (AMAC-R)  J9013/N (AMAC-3)  J9013/N (AMAC-4)  J9013/N (AMAC-5)  J9013/N (AMAC-6)

②    ② ③ ④ ⑤

▷ NOT CONNECTED IN 404A1, NUCLEAR WEAPON CONTROL PANEL

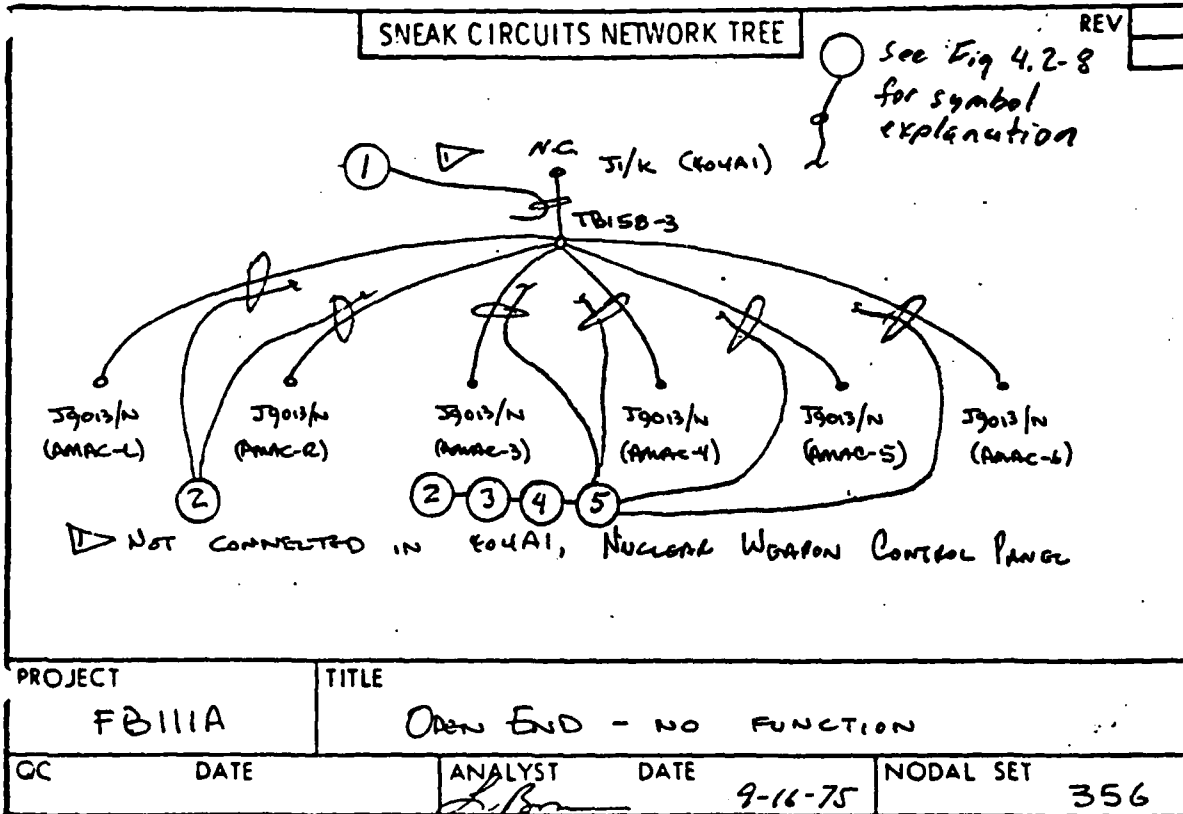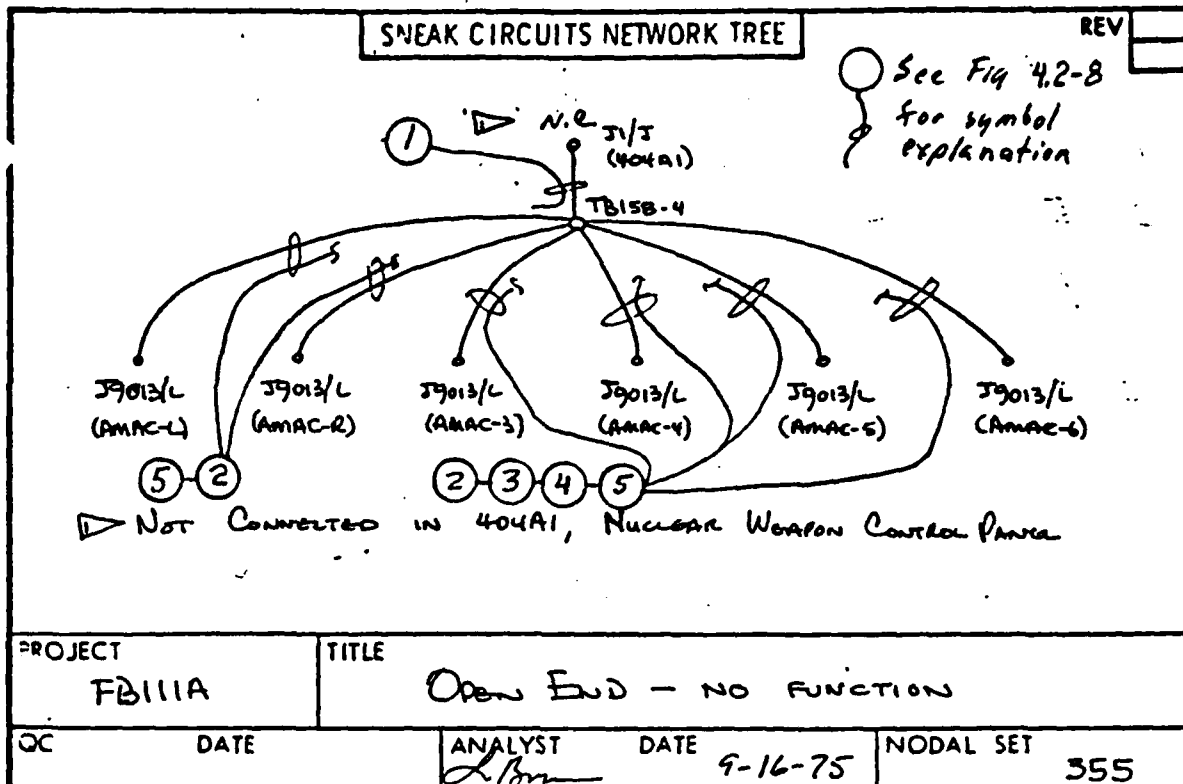| PROJECT | TITLE | | | |
|---|---|---|---|---|
| FB111A | OPEN END — NO FUNCTION | | | |
| QC | DATE | ANALYST | DATE 9-16-75 | NODAL SET 356 |

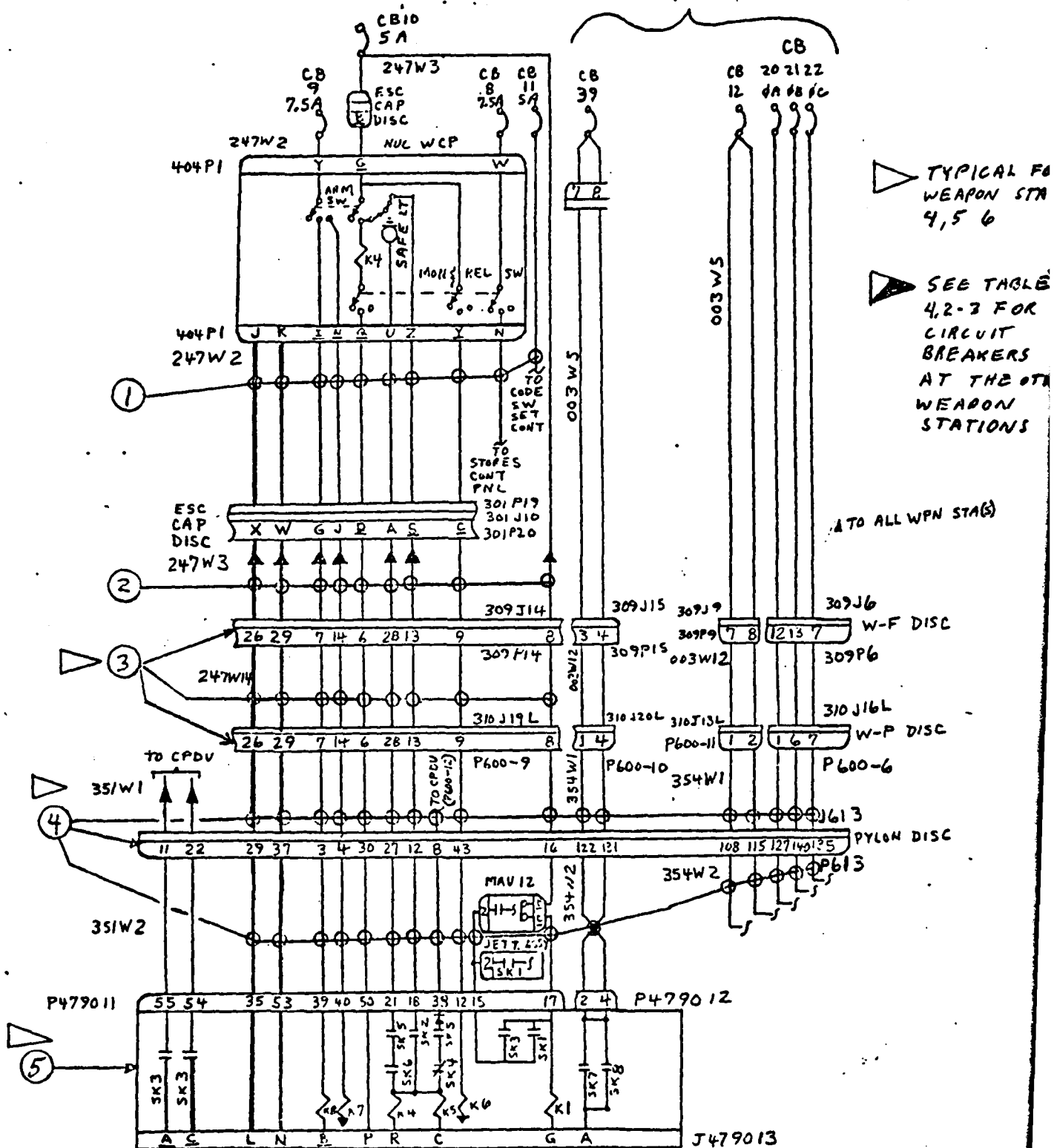FIGURE 4.2-10. NETWORK TREES 355 AND 356
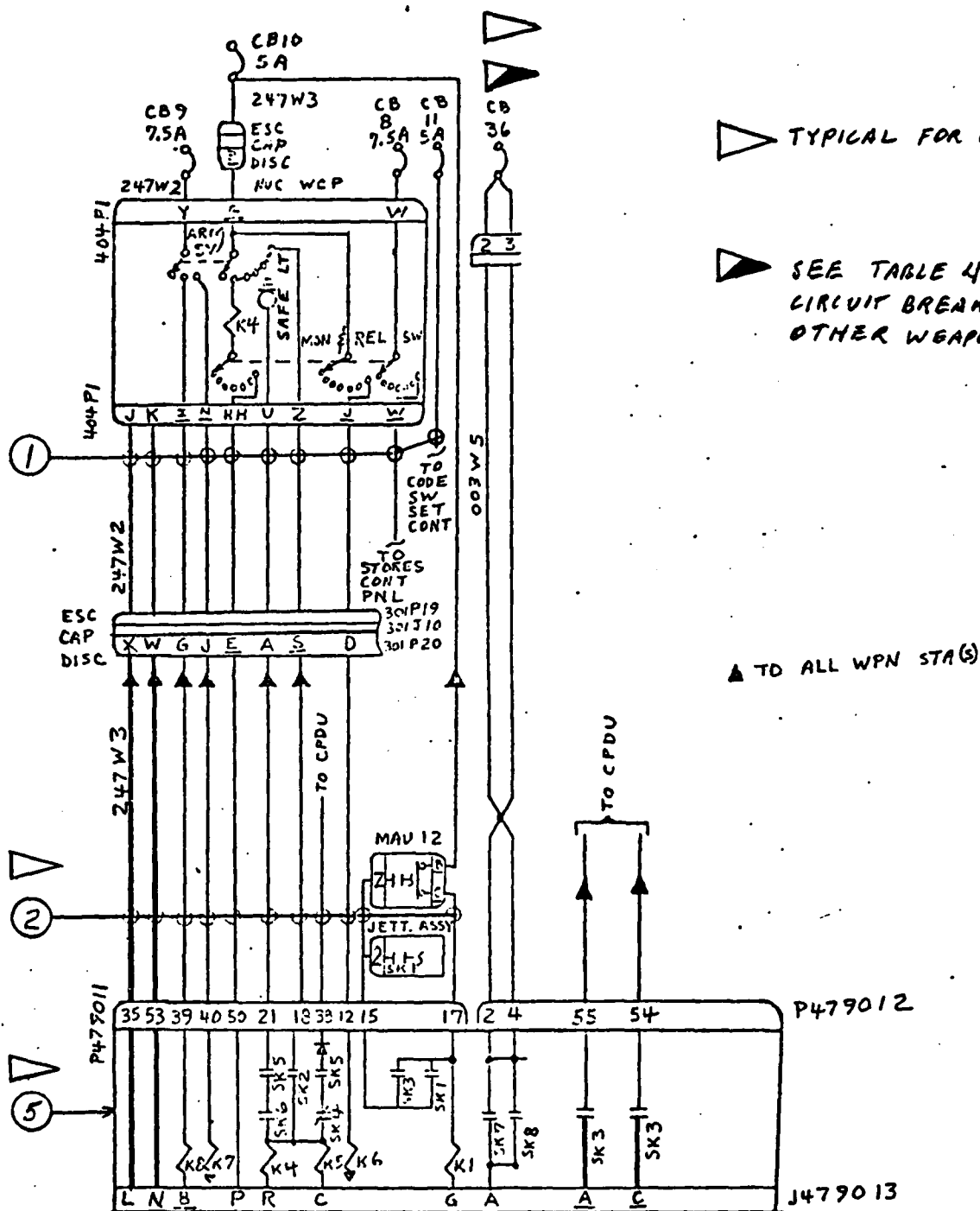
FIGURE 4.2-11.  FAULT DIAGRAM WEAPON STATION 3

FIGURE 4.2-12. FAULT DIAGRAM WEAPON STATION R

## 4.2.6.3 (Continued)

### TABLE 4.2-3
### POTENTIAL FAULT POWER SOURCES

| FIGURE INDICATOR | | CIRCUIT BREAKER | POWER |
|---|---|---|---|
| ① | | CB8 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB11 (5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ② ③ | | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ④ | | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷3 | CB20 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | | CB21 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | | CB22 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | | CB12 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | | CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷4 | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | | CB29 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | | CB19 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | | CB32 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | | CB33 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ▷5 | CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | | CB13 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | | CB16 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | | CB17 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | | CB18 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | ▷6 | CB34 (20A) UNIT 304A1 | 28 VDC ESS BUS |
| | | CB30 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | | CB26 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| | | CB24 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| | | CB23 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| ⑤ | | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷3 | CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷R | CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷L | CB37 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷4 | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷5 | CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ▷6 | CB34 (20A) UNIT 304A1 | 28VDC ESS BUS |

▷R STA R ONLY    ▷L STA L ONLY    ▷3 STA 3 ONLY    ▷5 STA 5 ONLY

▷6 STA 6 ONLY    ▷4 STA 4 ONLY

4.2.6.4   Circuit Analysis Package, Weapon Interface Pin b of AMAC SPU-3
and -R (Weapon Station 3 Pylon and Weapon Station R-Bay)

These interfaces are shown in Figure 4.2-13 Sneak Circuits Network Tree 318,
Figure 4.2-D, which is a copy of Figure 1-8 from T.O. 1F-111(B)A-2-11-1
(Change 2) showing the circuitry to the pivot pylon weapon station AMAC SPU
interfaces and Figure 4.2-F which is a copy of Figure 1-10 from T.O.
1F-111(B)A-2-11-1 (Change 2) showing the circuitry to L and R-Bay AMAC SPU
interfaces.   Maximum current available to the interfaces in a normal environ-
ment is 48 mA (direct current).   Worst case current at 28VDC in an abnormal
(faulted) environment would be 608 amps for weapon station 3 and 1333 amps
for weapon station R.   Worst case fault current at 115VAC would be 198 mA
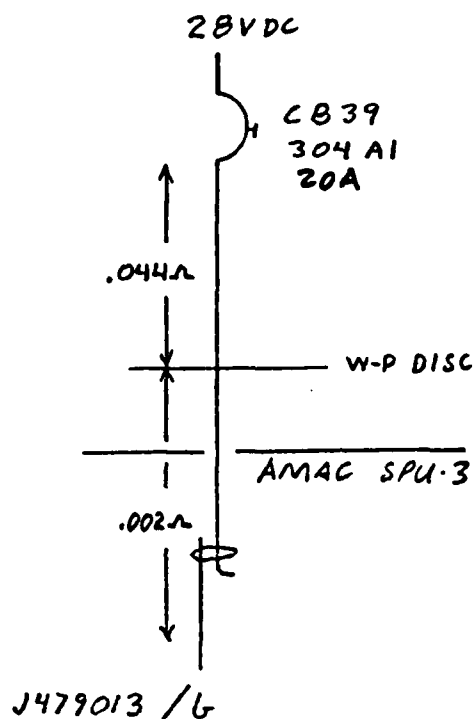for weapon station 3 and R.
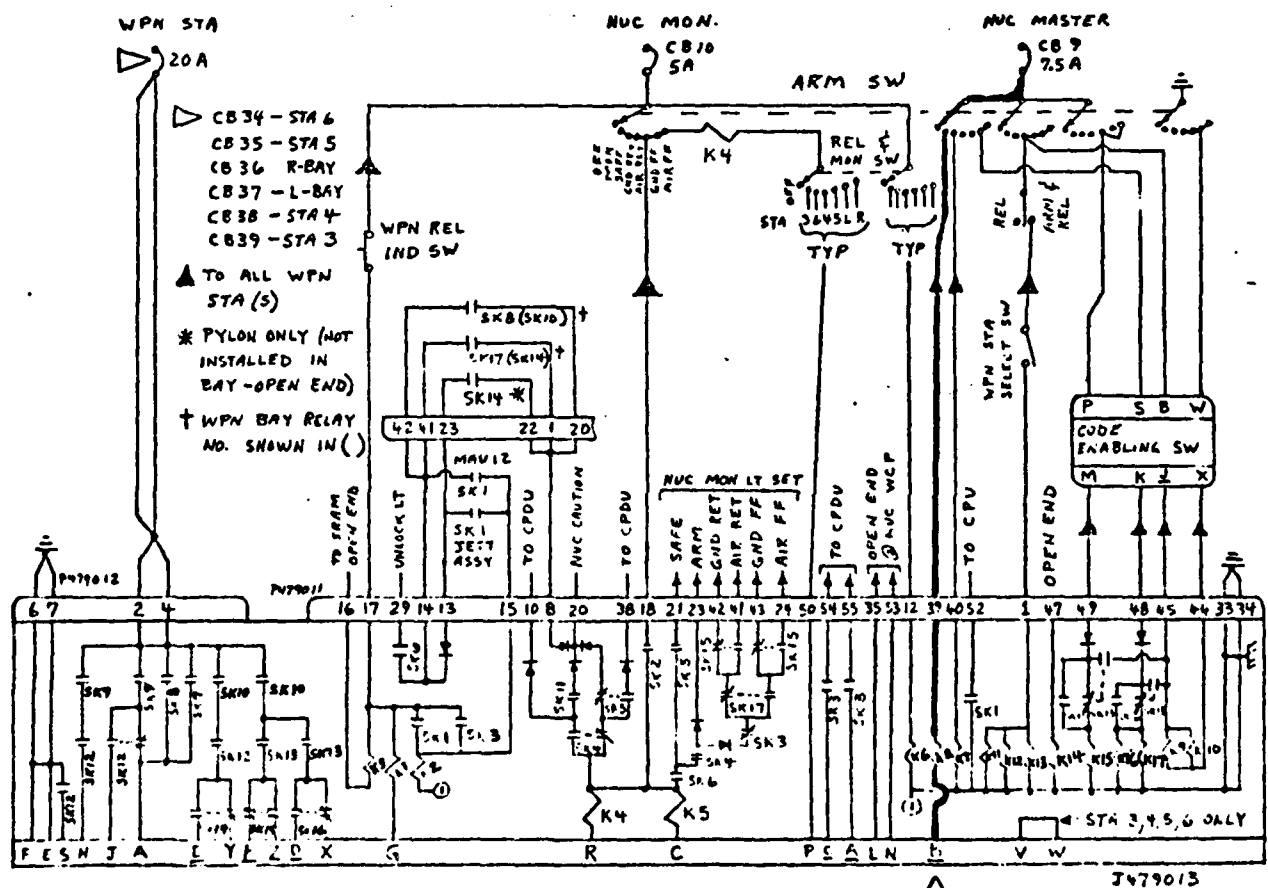


AMAC SPU INTERFACE

4.2.6.4

4.2.6.4    (Continued)

c.    <u>Worst Case Path For Weapon Station 3 at 28VDC</u>

Reference:   Path ⑤ from paragraph b.

28VDC

CB 39
304 AI
20A

.044 Ω

W-P DISC

AMAC SPU·3

.002 Ω

J479013 /6

Total resistance of path = .046 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.046} = \underline{608}$ A

Time = Less than .6 seconds at -54°C for circuit breaker to open.  On
ground alert the time to open would be less than .35 seconds
at 25°C.

4.2.6.4 (Continued)

d. <u>Worst Case Path for Weapon Station 3 At 115V 400Hz</u>

Reference path ④ from paragraph b.



Total resistance of path $\approx$ 580 $\Omega$

$V_{OC}$ = 115V 400Hz

$I_{SC} = \dfrac{115}{580} = \underline{198}$ mA

Per telecon with relay manufacturer, Leach, the thermistor and varistor inside the relay will probably open at this voltage causing a net increase in resistance. At 25$^{\circ}$C this is 800 $\Omega$ resulting in an $I_{SC}$ of 144 mA.

4.2.6.4    (Continued)

e.    <u>Worst Case Path For Weapon Station R At 28VDC</u>

Reference path ⑤ from paragraph b.

28VDC

CB36
304A1
20A

.021 Ω

AMAC SPU-R

J479013/6

Total resistance of path = .021 Ω

$V_{OC}$ = 28VDC
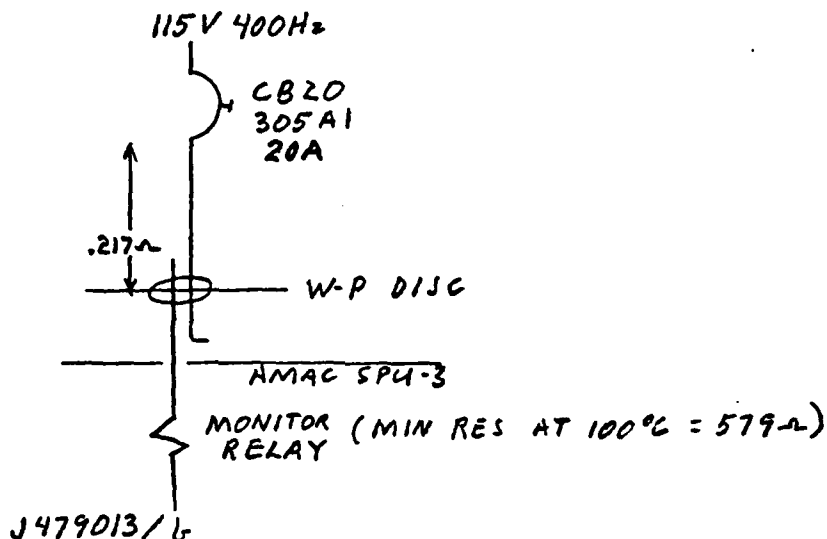
$I_{SC} = \dfrac{28}{.021} = \underline{1333}$ A

Time = Less than .6 seconds at -54°C for circuit breaker to open.

On ground alert the time to open would be less than .35 seconds at 25°C.

4.2.6.4    (Continued)

f.   <u>Worst Case Path for Weapon Station R at 115V 400Hz</u>

Reference path ④ from paragraph b.



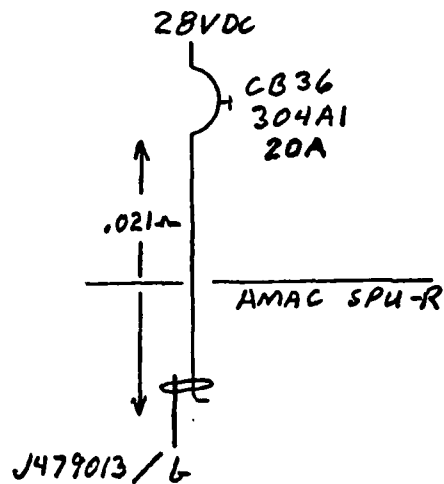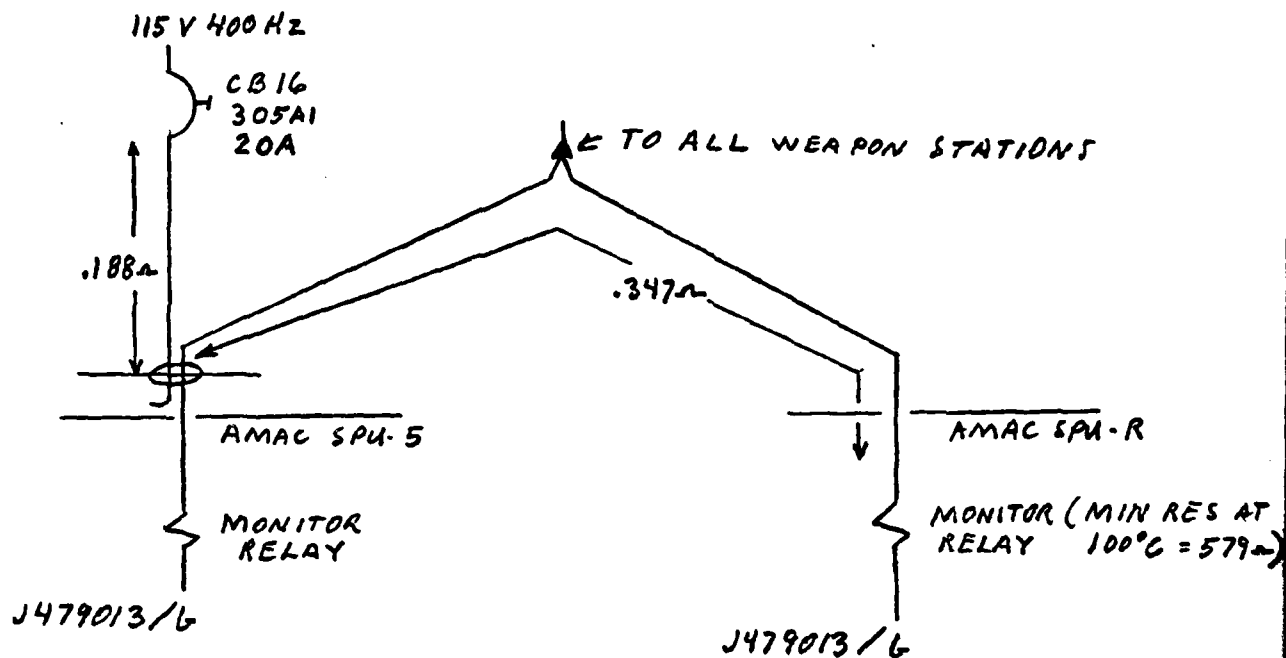Total resistance of path $\approx$ 580 $\Omega$

$V_{OC}$ = 115V 400 Hz

$I_{SC} = \frac{115}{580} = \underline{198}$ mA

Per telecon with relay manufacturer, Leach, the thermistor and varistor inside the relay will probably open at this voltage causing a net increase in resistance. At $25^{\circ}C$ this would be    800 $\Omega$ resulting in an $I_{SC}$ of 144 mA.

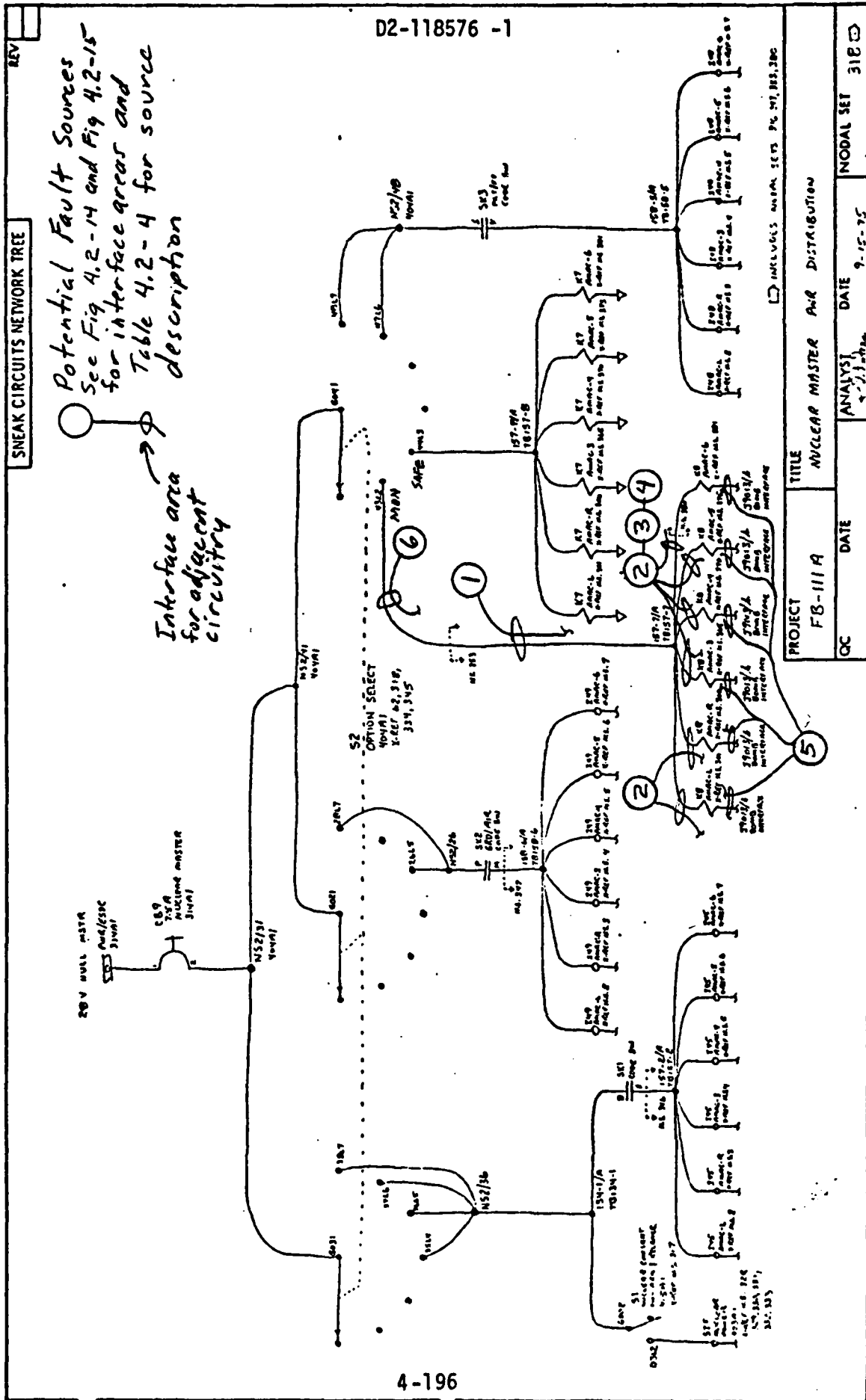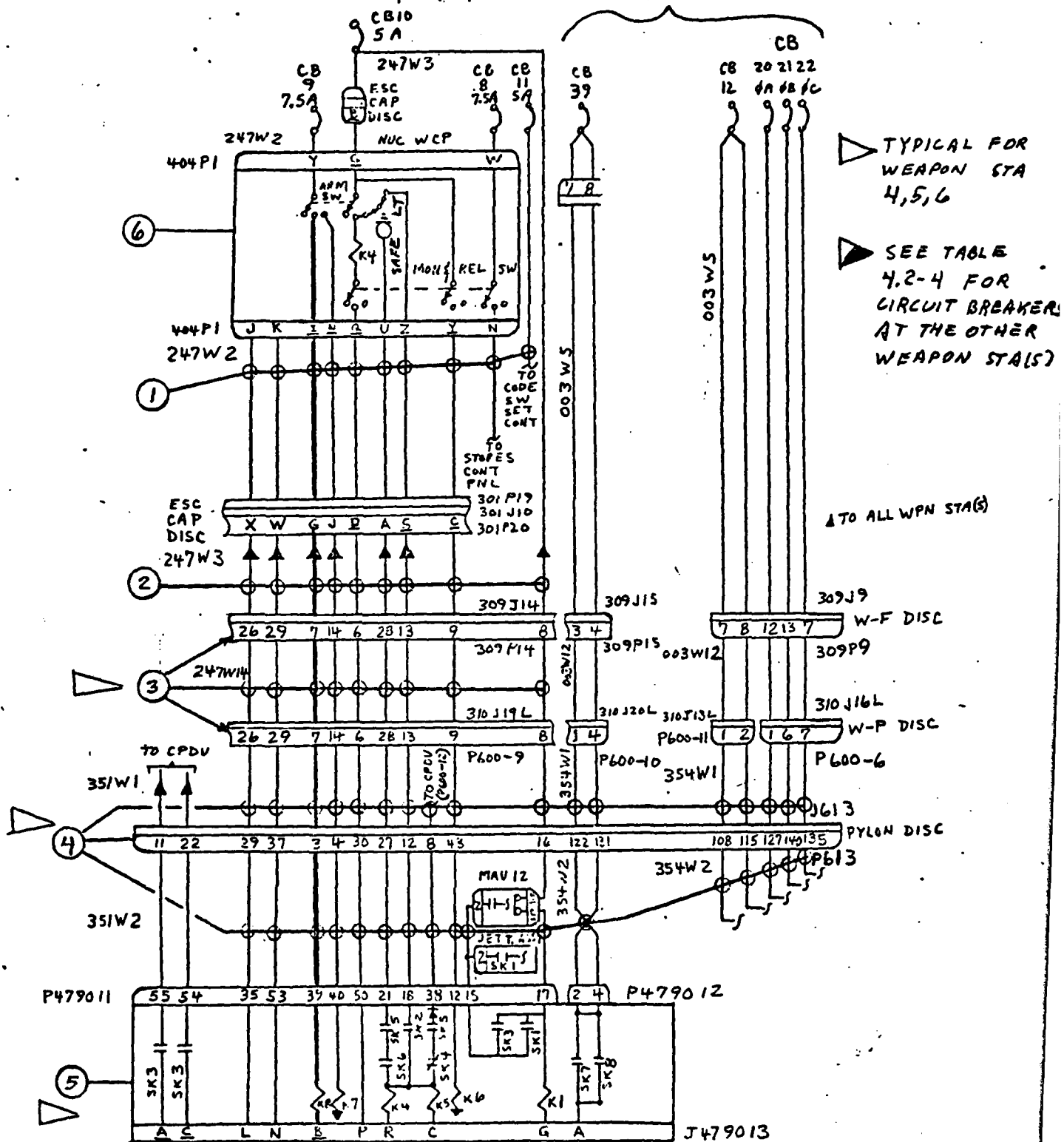FIGURE 4.2-13. NETWORK TREE 318
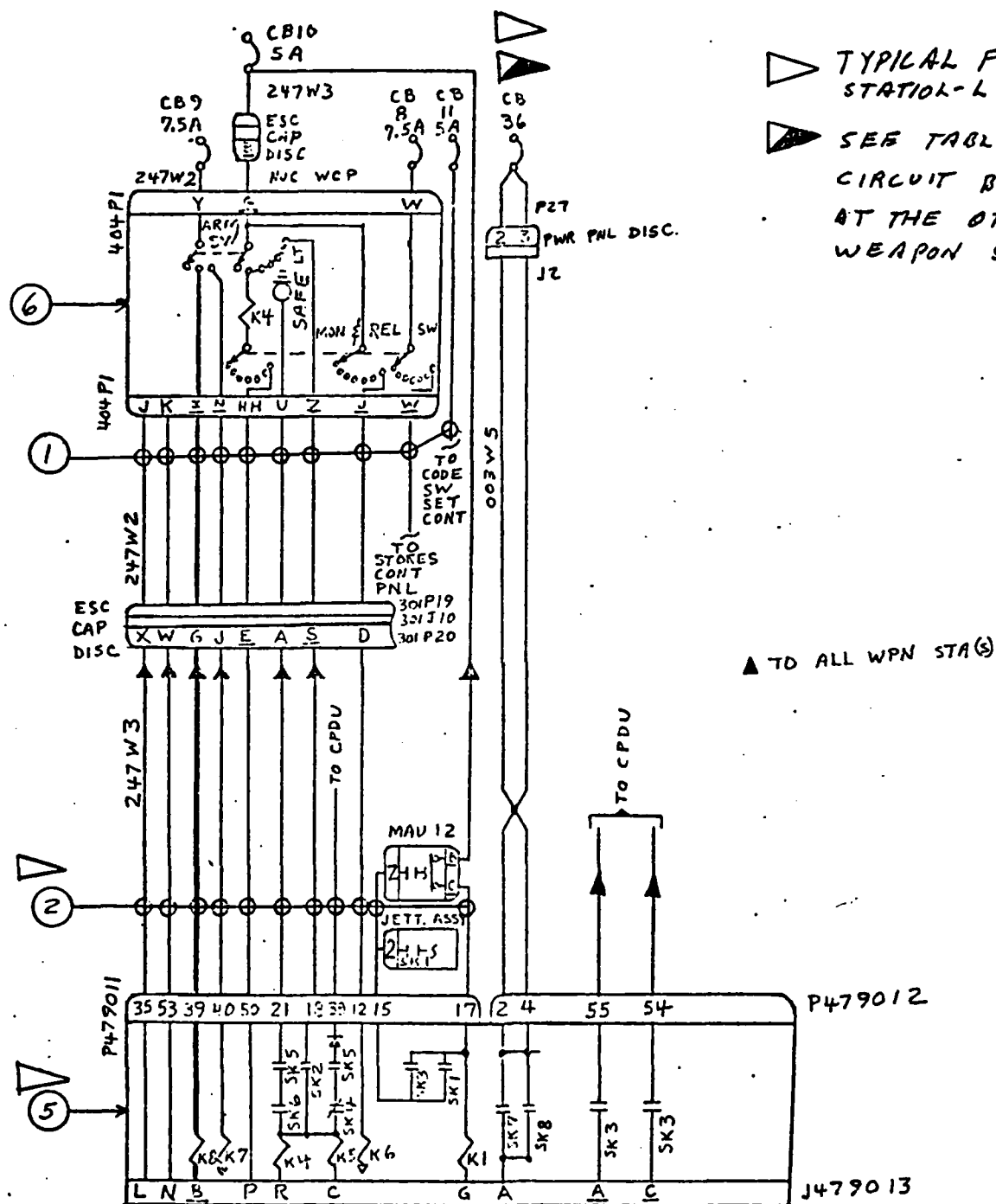
FIGURE 4.2-14    FAULT DIAGRAM WEAPON STATION 3

FIGURE 4.2-15    FAULT DIAGRAM WEAPON STATION R

?.6.4 (Continued)

TABLE 4.2-4

POTENTIAL FAULT POWER SOURCES

| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| ① | CB8 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB11 (5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ② ③ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ④ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ⟩3⟩ CB20 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩3⟩ CB21 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩3⟩ CB22 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩3⟩ CB12 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | ⟩3⟩ CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩4⟩ CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩4⟩ CB29 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | ⟩4⟩ CB19 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩4⟩ CB32 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩4⟩ CB33 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | ⟩5⟩ CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩5⟩ CB13 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | ⟩5⟩ CB16 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | ⟩5⟩ CB17 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | ⟩5⟩ CB18 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | ⟩6⟩ CB34 (20A) UNIT 304A1 | 28 VDC ESS BUS |
| | ⟩6⟩ CB30 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | ⟩6⟩ CB26 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| | ⟩6⟩ CB24 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | ⟩6⟩ CB23 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| ⑤ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩3⟩ CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩R⟩ CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩L⟩ CB37 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩4⟩ CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩5⟩ CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | ⟩6⟩ CB34 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ⑥ | CB8 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |

⟩R⟩ STA R ONLY　　⟩L⟩ STA L ONLY　　⟩3⟩ STA 3 ONLY　　⟩5⟩ STA 5 ONLY

⟩6⟩ STA 6 ONLY　　⟩4⟩ STA 4 ONLY　　4-199

4.2.6.5    Circuit Analysis Package, Weapon Interface Pins C, G, R of
           AMAC-SPU-3 and -R (Weapon Station 3 Pylon and Weapon Station
           R Bay)

These interfaces are shown in Figure 4.2-16 and 4.2-17 Sneak Circuits
Network Tree, Figure 4.2-D, which is a copy of Figure 1-8 from T.O.
1F-111(B) A-2-11-1 (Change 2) showing the circuitry to the pivot pylon
weapon station AMAC SPU interfaces and Figure 4.2-F which is a copy of
Figure 1-10 from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the cir-
cuitry to L and R-Bay AMAC SPU interfaces.  Maximum current available
to the interfaces in a normal environment is 48 mA (direct current).
Worst case current at 28VDC in an abnormal (faulted) environment would
be 608 amps for weapon station 3 and 1333 amps for weapon station R.
Worst case fault current at 115VAC would be 198 mA for weapon station 3
and R.
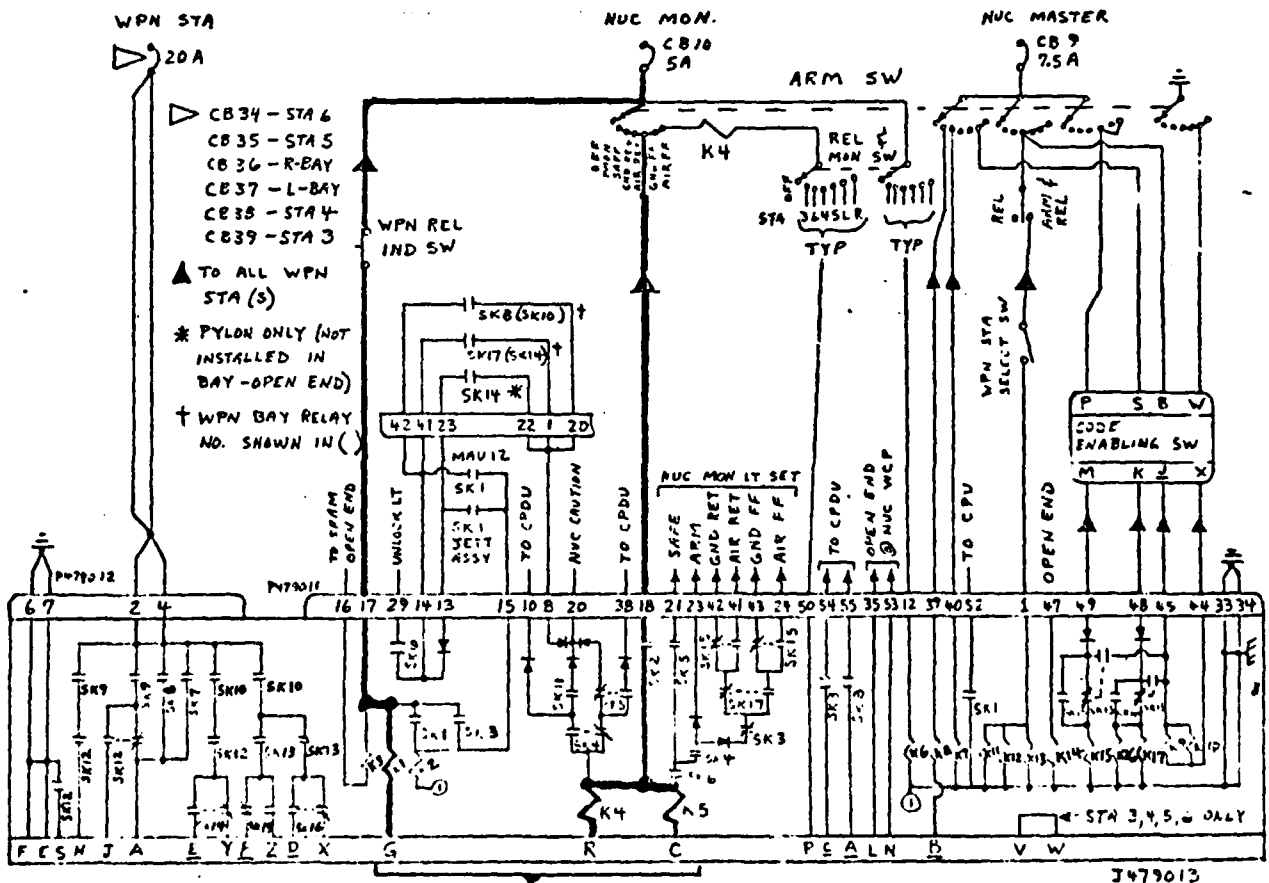


AMAC SPU INTERFACE                          4.2.6.5

4.2.6.5   (Continued)

a.   Normal Power and Load Analysis

Reference:   Figures 4.2-16 and 4.2-17 Network Tree 1, Figure 4.2-18
Network Tree 334, Monitor-Relay Technical Data

From examination of the network tree

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{579} = \underline{48}$ mA for pin G

$I_{SC} = \dfrac{28}{579} = \underline{48}$ mA for pins R&C when the Option Select switch
on the Nuclear Weapons Control Panel is in any
position except off.

b.   Fault Analysis

Reference:   Figure 4.2-16 and 4.2-17 Network Tree 1, Figure 4.2-18
Network Tree 334, Figure 4.2-19 Fault Diagram for
Weapon Station 3 and Figure 4.2-20 Fault Diagram for
Weapon Station R.

Since the wiring to pins C, G, and R is bussed to all nuclear
weapons stations any 28VDC or 115V 400Hz power that might fault
into these circuits for any weapon station will propagate to all
weapon stations.

(1)   Wiring Harness 247 W2 Damaged
Wires to pin C or R shorted to 28VDC.  See Table 4.2-5 for
voltage sources.

(2)   Wiring Harness 247 W3 Damaged
Wires to pin C, G or R shorted to 28VDC.  See Table 4.2-5 for
voltage sources.

(3)   Wiring Harness 247 W14, 247 W15, Wing-Fuselage
Disconnect 308 J13, 308 J14, 309 J13, 309 J14 or Pylon 3, 4,
5, or 6 Wing-Pylon Disconnect Damaged

Wires to pin C, G, or R shorted to 28VDC.  See Table 4.2-5 for
voltage sources.

4.2.6.5   (Continued)

b.   (Continued)

④   Pylon 3, 4, 5, 6 Wiring Harness 351 W1, 351 W2, 354 W1, 354 W2
or Pylon Disconnect J613 Damaged

Wires to pin C, G, or R shorted to 28VDC or 115V 400 Hz.  See
Table 4.2-5 for voltage sources.

⑤   AMAC SPU Damaged

Wires to pin C, G, or R shorted to 28VDC.  See Table 4.2-5 for
voltage sources.

⑥   Nuclear Weapons Control Panel Damaged

Wires to pin C or R shorted to 28VDC.  See Table 4.2-5 for
voltage sources.

4.2.6.5    (Continued)

c.  <u>Worst Case Path For Weapon Station 3 at 28 VDC</u>

Reference path⑤from paragraph b.

28VDC

CB 39
304A1
20A

.044 Ω

W-P DISC

AMAC SPU-3

.002 Ω
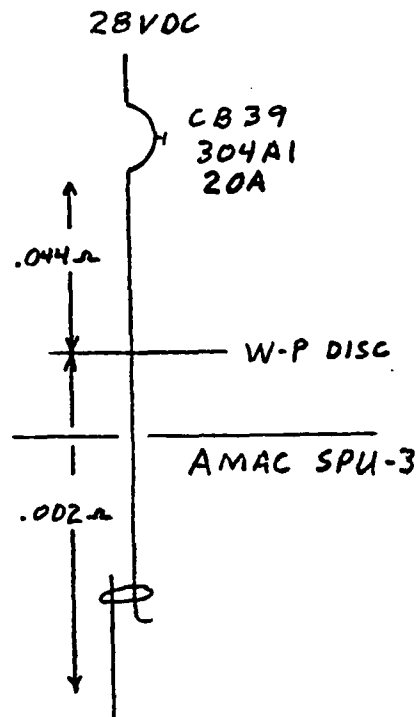
J479013/C (Typical for G and R)

Total resistance of path = .046 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \frac{28}{.046} = \underline{608}$ A

Time = Less than .6 seconds at -54°C for circuit breaker to open.

On ground alert at 25°C, the time to open would be less than
.35 seconds.

4.2.6.5    (Continued)

d.  <u>Worst Case Path for Weapon Station 3 at 115V 400Hz</u>

Reference path④from paragraph b.



J479013/C (Typical for G and R)

Total resistance of path $\approx$ 580 $\Omega$

$V_{OC}$ = 115V 400Hz

$I_{SC} = \dfrac{115}{580}$ = <u>198</u> mA

Per telecon with relay manufacturer, Leach, the thermistor and var-
istor inside the relay will probably open at this voltage causing
a net increase in resistance.  At $25^{\circ}$C this is 800 ohms resulting
in an $I_{SC}$ of 144 mA.

4.2.6.5    (Continued)

e.    <u>Worst Case Path for Weapon Station R at 28VDC</u>

Reference path ⑤ from paragraph b.

28VDC

CB 36
304 A1
20A

.021 Ω

AMAC SPU R
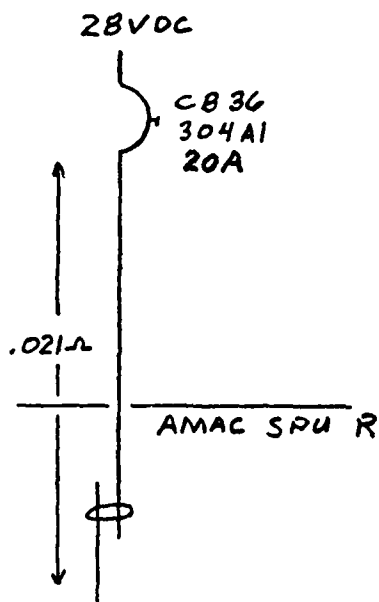
J479013/C (Typical for R and C)
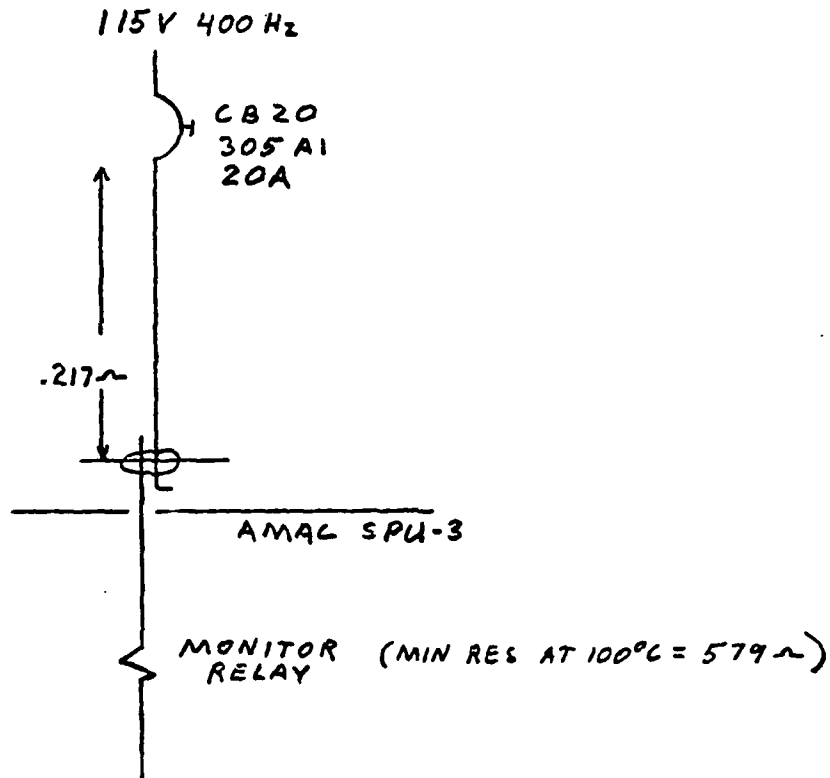
Total resistance of path = .021 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.021} = \underline{1333}$ A

Time = Less than .6 seconds at -54$^\circ$C for circuit breaker to open.

On ground alert at 25°C, the time to open would be less than .35 seconds.

4.2.6.5    (Continued)

f.    Worst Case Path for Weapon Station R at 115V 400Hz

Reference path ④ from paragraph b.
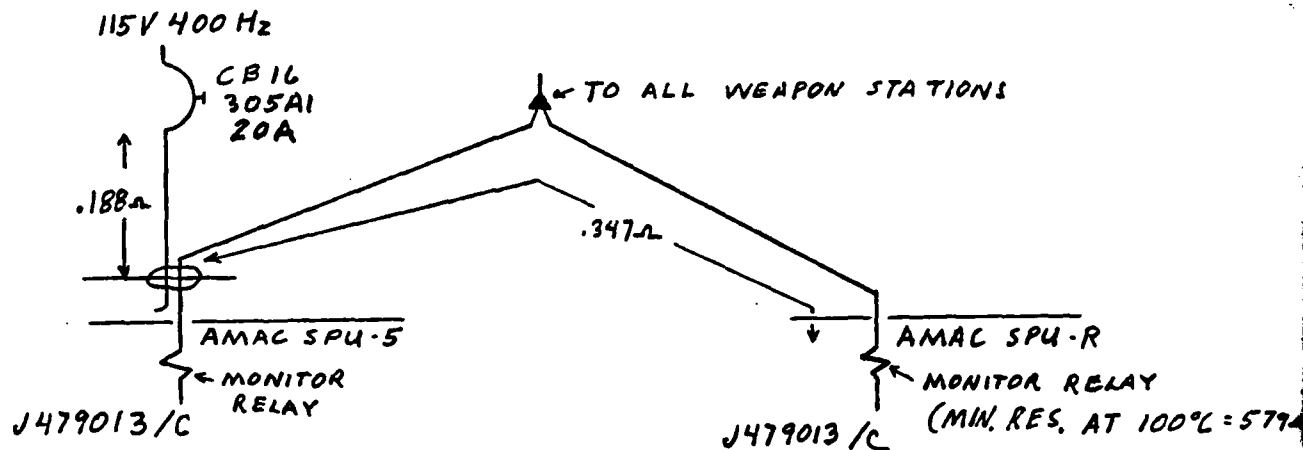


Typical for G and R

Total resistance of path approximately 580 ohms

$V_{OC}$ = 115V 400Hz

$I_{SC} = \frac{115}{580} = \underline{198}$ mA

Per telecon with relay manufacturer, Leach, the thermistor and varistor inside the relay will probably open at this voltage causing a net increase in resistance.  At 25°C this would be approximately 800 ohms resulting in an $I_{SC}$ of 144 mA.

FIGURE 4.2-16   NETWORK TREE/STATION 3

FIGURE 4.2-17 NETWORK TREE/STATION R

FIGURE 4.2-18  NETWORK TREE 334

FIGURE 4.2-19    FAULT DIAGRAM WEAPON STATION 3
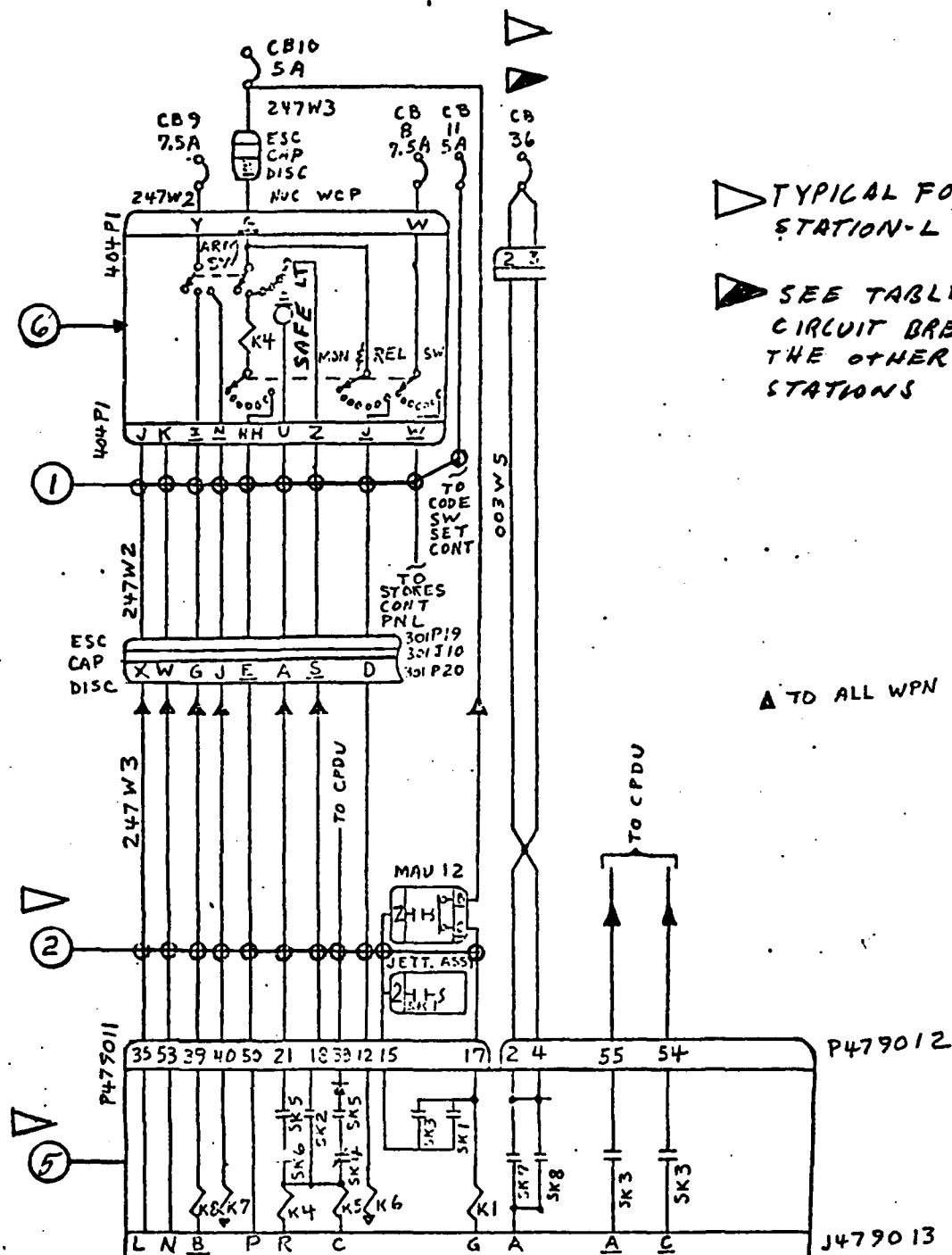
FIGURE 4.2-20    FAULT DIAGRAM WEAPON STATION R

4.2.6.5 (Continued)

TABLE 4.2-5

POTENTIAL FAULT POWER SOURCES

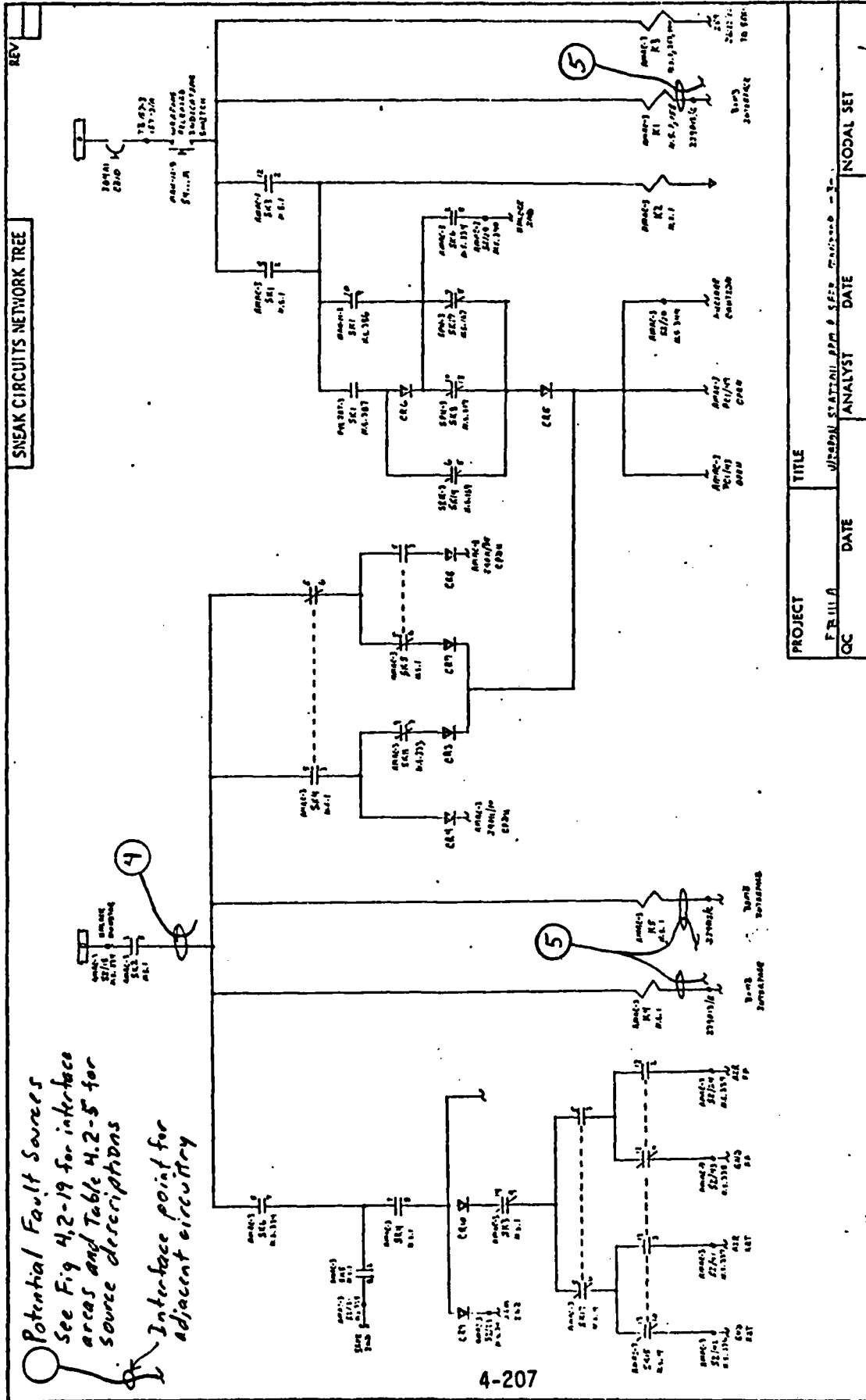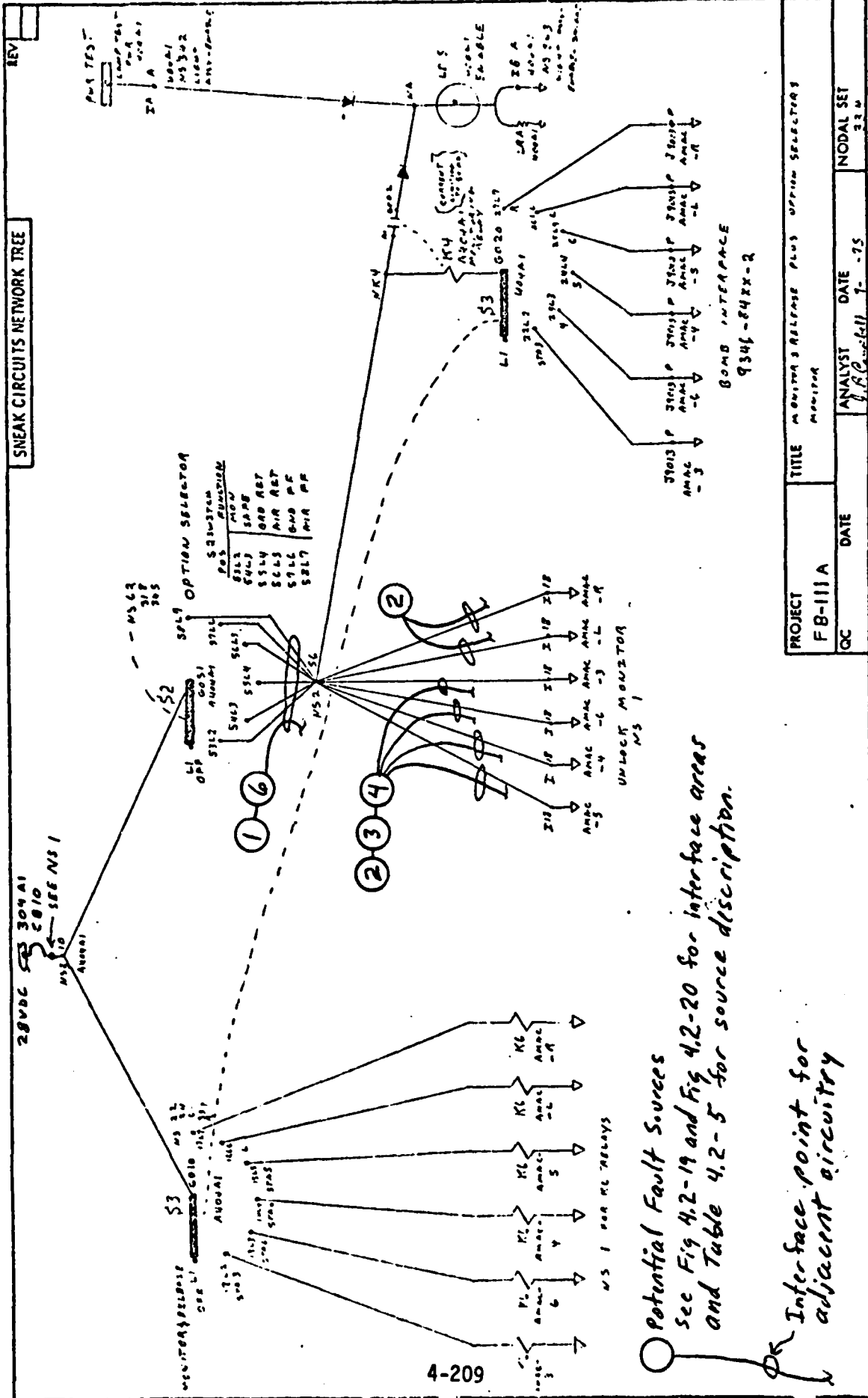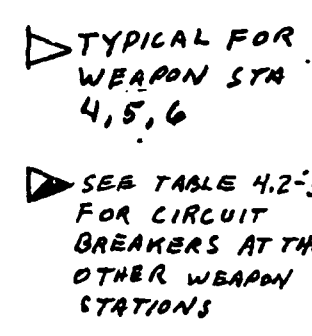| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| ① | CB8 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB11 (5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ② ③ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ④ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ▷3 | CB20 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | CB21 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | CB22 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | CB12 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷4 | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB29 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB19 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | CB32 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| | CB33 (20A) UNIT 305A1 | 115VAC 400Hz L MAIN BUS |
| ▷5 | CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | CB13 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB16 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | CB17 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| | CB18 (20A) UNIT 305A1 | 115VAC, 400Hz R MAIN BUS |
| ▷6 | CB34 (20A) UNIT 304A1 | 28 VDC ESS BUS |
| | CB30 (35A) UNIT 315A1 | 28VDC MAIN BUS |
| | CB26 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| | CB24 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| | CB23 (20A) UNIT 305A1 | 115VAC, 400Hz, R MAIN BUS |
| ⑤ | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| ▷3 | CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷R | CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷L | CB37 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷4 | CB38 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷5 | CB35 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ▷6 | CB34 (20A) UNIT 304A1 | 28VDC ESS BUS |
| ⑥ | CB8 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |

▷R STA R ONLY    ▷L STA L ONLY    ▷3 STA 3 ONLY    ▷5 STA 5 ONLY

▷6 STA 6 ONLY    ▷4 STA 4 ONLY

4.2.6.6    Circuit Analysis Package Weapon Interface Pins S, V and W of
           AMAC SPU-3 and -R (Weapon Station 3 Pylon and Weapon Station
           R Bay)

These interfaces are shown in Figures 4.2-21 and 4.2-22 Sneak Circuit
Network Trees 364 and 360, Figure 4.2-D, which is a copy of Figure 1-8
from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the circuitry to the pivot
pylon weapon station AMAC SPU interfaces and Figure 4.2-F which is a copy
of Figure 1-10 from T.O. 1F-111(B)A-2-11-1 (Change 2) showing the cir-
cuitry to L and R-Bay AMAC SPU interfaces.  Maximum current and voltage
to pin S interface in a normal environment is 0.  Current and voltage to
pins V and W in a normal environment is controlled by the weapon itself.
Worst case current at 28VDC in an abnormal faulted environment is 608
amps for Pins S, V and W for weapon station 3.  Worst case fault current
at 28VDC for weapon station R is 1333 amps at pin S.
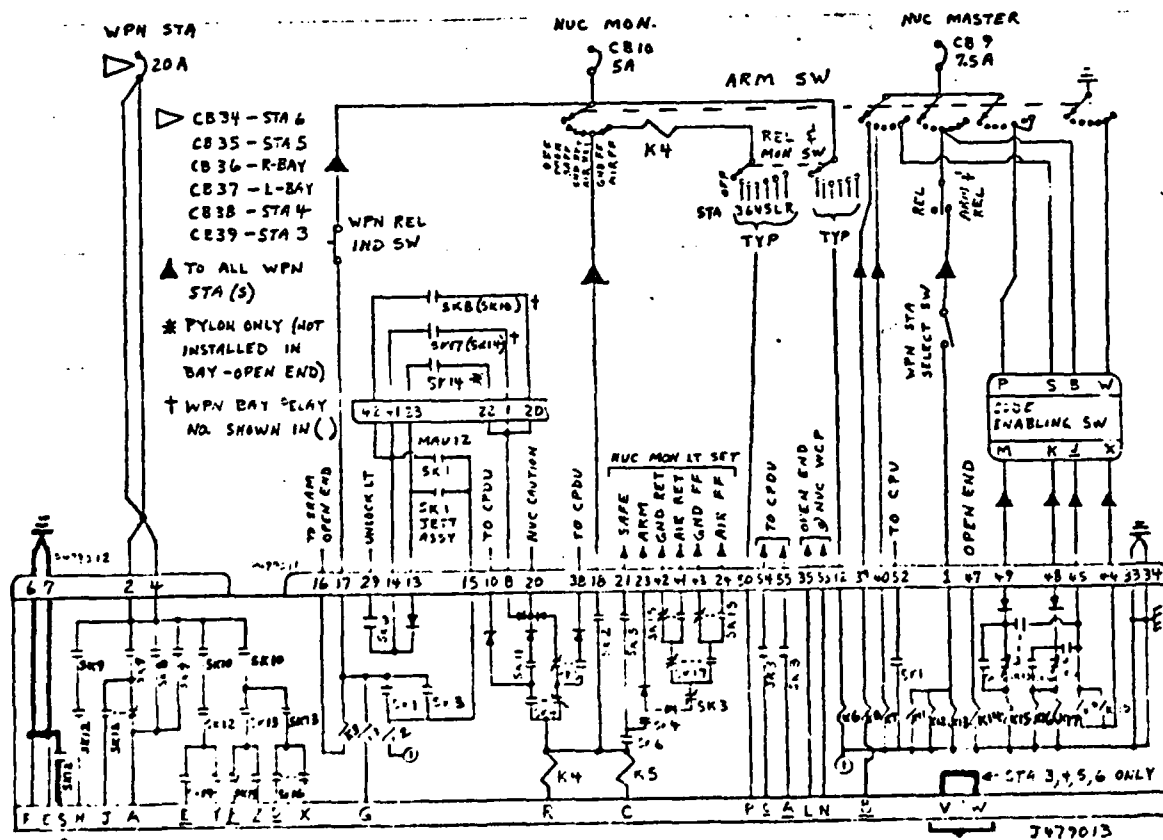


AMAC SPU INTERFACE

4.2.6.6                                                        4.2.6.6

4.2.6.6 (Continued)

a. Normal Power and Load Analysis

Pin S

Reference figures 4.2-21 and 4.2-22 Network Trees 364 and 360. Relay K12 in the AMAC SPU is only energized when an arming function is being commanded. From inspection of the network trees

$$V_{OC} = 0 \text{ V}$$
$$I_{SC} = \underline{0} \text{ A}$$

Pins V and W

Reference Figure 4.2-23 Fault Diagram for Weapon Station 3 Pins V and W are connected only to each other only in the pylon AMAC SPU's. Thus the power is determined by the weapon circuitry.

b. Fault Analysis

Reference Figure 4.2-21 Network Tree 364, Figure 4.2-22 Network Tree 360, Figure 4.2-23 Fault Diagram Weapon Station 3 and Figure 4.2-24 Fault Diagram Weapon Station - R.

(1) AMAC SPU Damaged

Wires to subject pins shorted to 28VDC. See Table 4.2-6 for the voltage sources. Since pin S is switching a ground into the weapon and K12 is only energized by an arming command the worst case fault could be relay K12 damaged such that the contacts are shorted or wires to pin S shorted to ground.

c.  Worst Case Path for Weapon Station 3

Reference path ① from paragraph b.

28VDC                          28VDC

CB39                           CB39
30441                          304A1
20A                            20A

.044Ω                          .044Ω

W-P DISC                       W-P DISC

AMAC SPU-3                     AMAC SPU-3

.002Ω                          .002Ω

J479013/S                      J49013/V      W
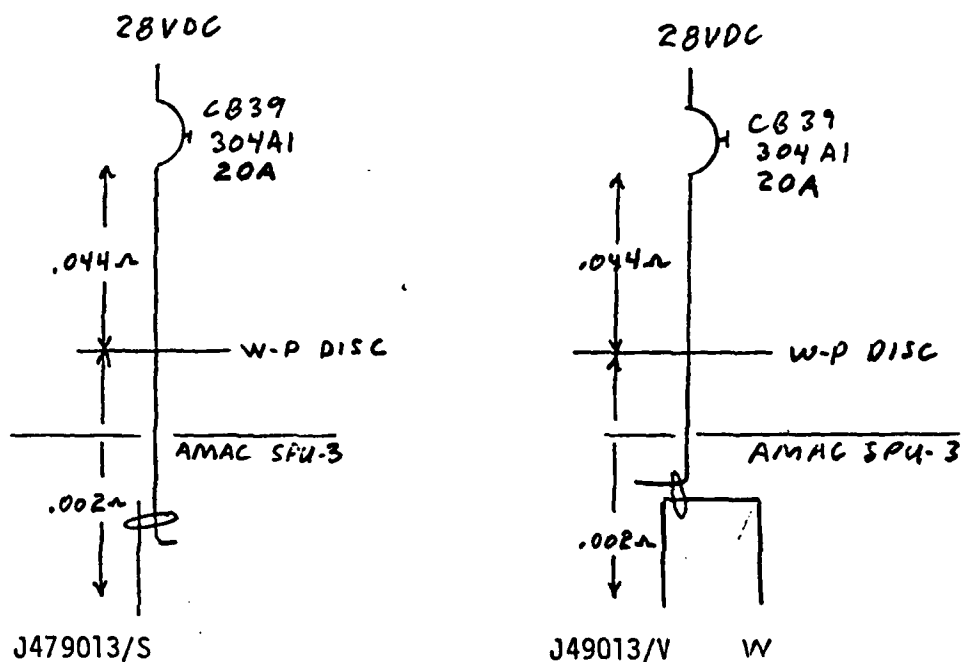
For maximum current calculations
only one pin at a time is assumed
grounded at the weapon interface.

Total resistance of each path = .046 Ω

$$V_{OC} = 28VDC$$

Pin S

$$I_{SC} = \frac{28}{.046} = \underline{608} \text{ A}$$

Time = Less than .6 seconds at $-54^{O}C$ for the circuit breaker
       to open.  On ground alert at $25^{O}C$ the time to open
       would be less than .35 seconds.

4-215

4.2.6.6 (Continued)

d. <u>Worst Case Path For Weapon Station R</u>

Reference path ①from paragraph b.



J479013/S
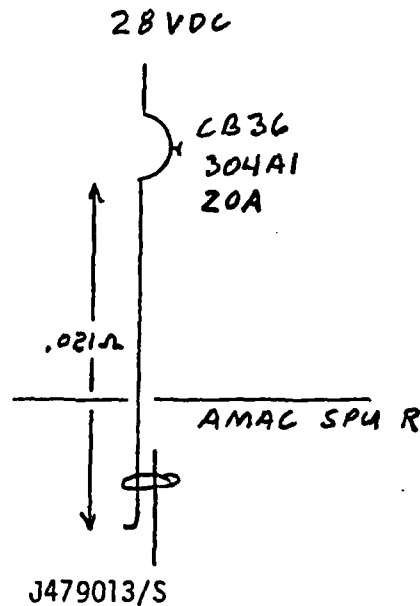
Total resistance at path = .021 Ω

$V_{OC}$ = 28VDC

$I_{SC} = \dfrac{28}{.021} = \underline{1333A}$

Time = Less than .6 seconds at $-54^{O}C$ for the circuit breaker
to open. On ground alert at $25^{O}C$ the time for the
circuit breaker to open would be less than .35 seconds.

| SNEAK CIRCUITS NETWORK TREE | REV |
|---|---|
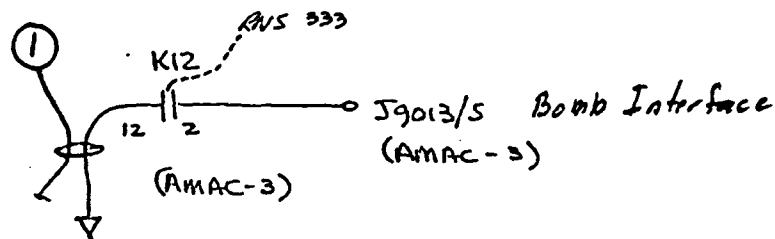


"AMAC-3 SPU STATION SELECT" PICKS UP K12
AND SWITCHES GND INTO WEAPON WHEN
"OPTION SELECT" SWK. IS IN AN "ARM" POSITION
AND "NUCLEAR CONSENT" SWK. IS IN "ARM &
RELEASE" POSITION.

Potential Fault Sources
See Fig 4.2- for interface areas
and Table 4.2-6 for source descriptions

Interface point for
adjacent circuitry

| PROJECT | TITLE | | |
|---|---|---|---|
| FB111A | AMAC-3 "STATION 3 SELECT" | | |
| QC        DATE | ANALYST        DATE  9-18-75 | NODAL SET | 364 |

HOU-705        BOEING AEROSPACE COMPANY - HOUSTON, TEXAS

FIGURE 4.2-21. , NETWORK TREE 364

| SNEAK CIRCUITS NETWORK TREE | REV |
|---|---|
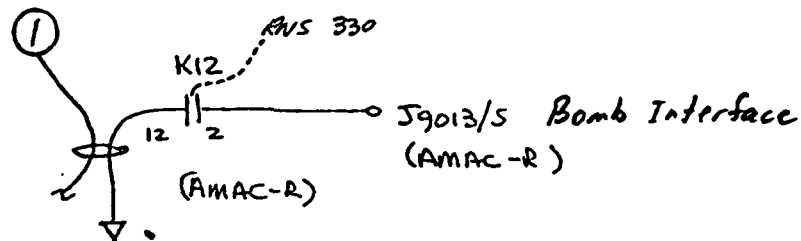


"AMAC-R SPU STATION SELECT" PICKS UP K12
AND SWITCHES GND INTO WEAPON WHEN
"OPTION SELECT" SWX. IS IN AN "ARM" POSITION
AND "NUCLEAR CONSENT" SWX. IS IN "ARM & RELEASE"
POSITION.

Potential Fault Sources
See Fig 4.2 - for interface areas
and Table 4.2 - 6 for source descriptions

Interface point for
adjacent circuitry

| PROJECT | TITLE | | | |
|---|---|---|---|---|
| FB111A | AMAC-R "STATION R SELECT" | | | |
| QC | DATE | ANALYST | DATE 9-18-75 | NODAL SET 360 |

HOU-205    BOEING AEROSPACE COMPANY · HOUSTON, TEXAS

FIGURE 4.2-22.   NETWORK TREE 360
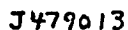
FIGURE 4.2-23.  FAULT DIAGRAM WEAPON STATION 3
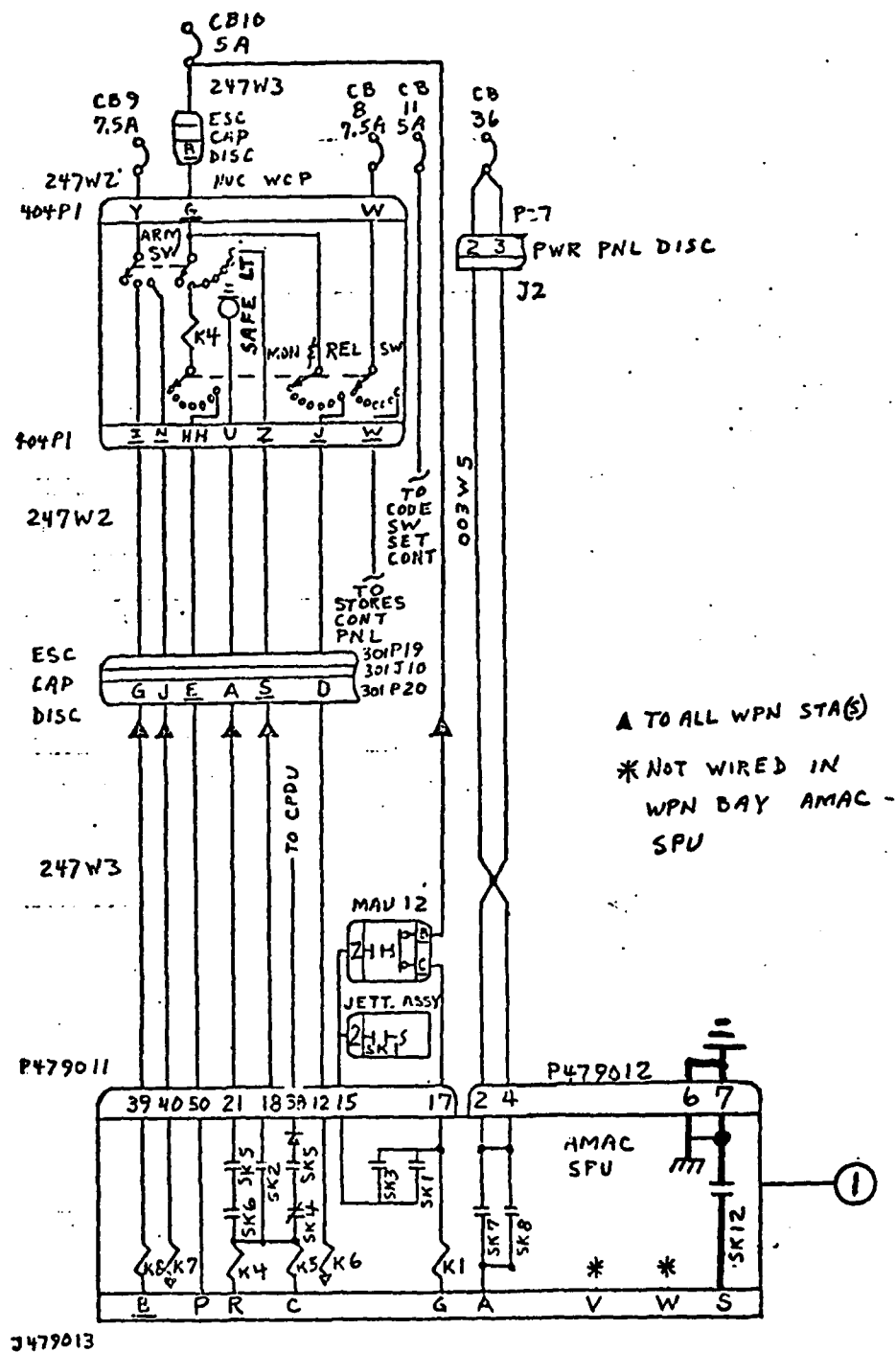
FIGURE 4.2-24.    FAULT DIAGRAM WEAPONS STATION R

4.2.6.6   (Continued)

TABLE 4.2-6

| FIGURE INDICATOR | CIRCUIT BREAKER | POWER |
|---|---|---|
| ① | CB9 (7.5A) UNIT 314A1 | 28VDC CREW STA ESS BUS |
| | CB10 (5A) UNIT 304A1 | 28VDC ESS BUS |
| | *CB36 (20A) UNIT 304A1 | 28VDC ESS BUS |
| | **CB39 (20A) UNIT 304A1 | 28VDC ESS BUS |

 *STATION R ONLY
**STATION 3 ONLY

## 4.3 ACCIDENT ANALYSIS

Boeing performed a system safety analysis of B-52 accident data as part of the power and load analysis.

### 4.3.1 Purpose

The purpose of the accident analysis was to provide generalized electrical damage modes and to determine the conditions under which they are feasible. The goal was to define the abnormal environments in terms of electrical faults that could be reasonably postulated for the power and load analysis of any aircraft.

### 4.3.2 Source Data

Boeing-Wichita supported this effort by providing data on eleven B-52 aircraft accidents and two incidents where damage to electrical wiring was documented or where nuclear weapons were known to have been carried. Four accidents (Cases 1, 2, 4 and 8) are known to have involved aircraft loaded with nuclear weapons. None of these weapons was detonated. The source material does not show that any stray power actually reached the weapon interfaces and Boeing investigators are unaware of any such findings. It is believed that all instances of weapons departing the aircraft involved structural failure due to inflight breakups and violent gyrations. Two taxi accidents (Cases 3 and 13) involved collision with the inboard external stores station. Damage would probably have been the same if other aircraft or large vehicles had struck parked B-52 aircraft. There are two instances of wheel well fire due to tire or hydraulic line failure (Cases 10 and 12). Other feasible locations for fire are crew compartment spaces where gear can be improperly stowed (Case 2); electrical equipment compartments (Case 7) or connectors exposed to excessive moisture (Case 6). Disintegrating engine components are feasible sources of shrapnel damage (Case 11) to electrical circuitry. Table 4.3-1 is a summary of the source data.

TABLE 4.3-1   CRASH/FIRE DAMAGE-SOURCE DATA

| CASE NO. | DESCRIPTION | AIRCRAFT IDENTITY | DATE | LOCATION | REMARKS |
|---|---|---|---|---|---|
| 1 | Wing Skin Failed during air refueling | B-52G 58-187 | 1-23-61 | Goldsboro, N.C. | Was armed with nuclear weapons |
| 2 | Fire in rear of crew compartment lower deck | B-52G 58-188 | 1-21-68 | Thule, Greenland | Was armed with nuclear weapons |
| 3 | Taxi collision with parked KC-97 tankers | B-52G 58-197 | 7-30-63 | Plattsburgh, AFB | |
| 4 | Mid-air collision with KC-135 tanker | B-52G 58-256 | 1-17-66 | SE Coast of Spain | Was armed with four nuclear weapons |
| 5 | Separation of forward fuselage due to hard nose gear landing | B-52H 60-006 | 6-3-74 | Wright Patterson AFB | |
| 6 | Electrical fire in connector due to moisture | B-52C 54-2671 | 11-20-68 | New Hampshire | |
| 7 | ALT/6B Power Supply fire | B-52F 57-154 | 12-10-70 | California | |
| 8 | Structural breakup due to exceeding 80° bank angle in turbulence | B-52D 55-060 | 1-13-64 | Cumberland, Md. | Was armed with nuclear weapons |
| 9 | Mid-air collision with tanker. Wing failed upon landing | B-52D 55-098 | 12-15-60 | Larson AFB, Washington | |
| 10 | Brake fire | B-52D 55-115 | 11-3-68 | Kadena AFB, Okinawa | |
| 11 | LH inboard engine starter disintegrated | B-52D 56-606 | 11-17-66 | Pease AFB, N.H. | |
| 12 | Hydraulic/electrical fire from blown tire damage | B-52F 57-053 | 8-6-62 | Barksdale AFB, Louisiana | |
| 13 | Collision with parked KC-135 | B-52F ,57-139 | 1-31-64 | Columbus AFB, Mississippi | GAM-77 penetrated nose of KC-135 |

### 4.3.4     Crash/Fire Damage Analysis

The damage analysis shows that electrical faults in abnormal environments are usually caused by structural breakups, fire or both. Damage mechanisms are either excessive physical forces, or high temperatures. In summary, the principle causes of damages to electrical circuits are:

       o   CRASH DUE TO COLLISION OR STRUCTURAL BREAKUP

       o   FIRE DUE TO:

                 CRASH

                 TIRE/HYDRAULIC FAILURE

                 ELECTRICAL FAILURE

                 IMPROPER STOWAGE

Table 4.3-2 shows the causes and effects of electrical damage for the cases selected from the source data.

### 4.3.4     Findings

The accident analysis found that almost any electrical fault mode is feasible under conditions of crash or fire. This includes opens, shorts to power and shorts to ground. These faults can occur in wiring, components or equipment assemblies. The most likely locations are leading edges of wings and struts, wheel well areas, equipment bays and crew compartments. There is at least one instance where weapons bay components were probably damaged during initial breakup. These findings are shown in Table 4.3-3.

TABLE 4.3-2   CRASH/FIRE DAMAGE ANALYSI    SET 1 OF 2)

| CASE NO. | OPERATIONAL MODE | ABNORMAL ENVIRONMENT | CAUSE | DAMAGE MECHANISM | ELECTRICAL CIRCUIT EFFECT(S) | ELECTRICAL FAULT(S) | PRIMARY LOCATION |
|---|---|---|---|---|---|---|---|
| 1. | FLIGHT - REFUELING/ PRELANDING CHECKS | CRASH/FIRE | STRUCTURAL BREAKUP OF RIGHT HAND WING. | TENSION ON WING WIRING FOLLOWED BY VIOLENT INERTIAL FORCES, IMPACT WITH GROUND AND FIRE. | WIRE BUNDLES SEVERED OPEN, AND GROUNDED TO STRUCTURE. COMPONENTS CRUSHED WIRE BUNDLES MELTED TOGETHER. | ADJACENT WIRE BUNDLES FAULTED OPEN. ALL EQUIPMENT FAULTED TO GROUND. ADJACENT WIRE BUNDLES SHORTED TOGETHER. | ALL INBOARD WING WIRING. |
| 2. | FLIGHT- CRUISE | FIRE | FOAM RUBBER SEAT CUSHION STOWED ON NAVIGATOR'S HOT AIR SPRAY TUBE UNDER SEAT. | HEAT FROM FIRE INTENSIFIED BY AIR BLAST AFTER ESCAPE HATCH JETTISONED. | CHARRED INSULATION IN WIRE BUNDLES. | ADJACENT WIRE BUNDLES SHORTED TOGETHER. | CREW COMPARTMENT. |
| 3. | GROUND- TAXI | CRASH | COLLISION WITH PARKED AIRCRAFT DUE TO BRAKE FAILURE. | IMPACT FORCES | CRUSHED AND SEVERED WIRING. | ADJACENT WIRES SHORTED TOGETHER. ADJACENT WIRE BUNDLES FAULTED OPEN OR SHORTED TO COMMON GROUND. | INBOARD LEADING EDGE AT EXTERNAL STORES MOUNT. |
| 4. | FLIGHT- REFUELING | CRASH/FIRE | BREAKUP OF FUSELAGE AT FORWARD BOMB BAY DUE TO COLLISION WITH TANKER, FOLLOWED BY SPIN AND IN-FLIGHT FIRE, ENDING WITH SCATTERED GROUND IMPACTS AND FIRES. | VIOLENT FORCES DUE TO IMPACT, INERTIA, GRAVITY AND WIND, FOLLOWED BY INTENSE FIRE, GROUND IMPACT AND FUEL-FED GROUND FIRES. | WIRE BUNDLES SEVERED OPEN, AND GROUNDED TO STRUCTURE. COMPONENTS CRUSHED. WIRES PINCHED TOGETHER. WIRE BUNDLES MELTED TOGETHER. | ADJACENT WIRE BUNDLES FAULTED OPEN. ADJACENT BUNDLES SHORTED TO COMMON GROUND. ALL EQUIPMENT SHORTED TO GROUND. ADJACENT WIRE BUNDLES SHORTED TOGETHER. | WEAPONS BAY IN FUSELAGE. |
| 5. | FLIGHT- LANDING | CRASH | FORWARD FUSELAGE SEPARATED FROM REST OF AIRCRAFT ON INITIAL FRONT GEAR IMPACT DUE TO FAILURE TO FLARE AIRCRAFT. | SUDDEN TENSILE IMPACT LOADS ON WIRING. | WIRE BUNDLES: SEVERED OPEN AND GROUNDED TO STRUCTURE. | ADJACENT WIRE BUNDLES FAULTED OPEN. ADJACENT WIRE BUNDLES SHORTED TO COMMON GROUND. | BODY PRODUCTION BREAK BULKHEAD FORWARD OF WING CENTER SECTION. |
| 6. | FLIGHT - LANDING APPROACH | FIRE | LOWER NOSE RADOME ELECTRICAL FIRE CAUSED BY ELECTRICAL SHORT IN CONNECTOR DUE TO MOISTURE IN THE PLUG. | HEAT AND ARCING. | CRACKED INSULATORS BETWEEN PINS IN BULKHEAD CONNECTORS. | SHORT CIRCUITS BETWEEN ADJACENT PINS. | FORWARD RADOME PRESSURIZED BULKHEAD. |
| 7. | FLIGHT- CRUISE | FIRE | MATERIAL FAILURE OF TRANSFORMER IN POWER SUPPLY PANEL. | EXPLOSION OF POWER SUPPLY FOLLOWED BY ELECTRICAL FIRE. | BADLY BURNED TRANSFORMER. (EXPLOSION SEVERED STEERING CABLE LINKAGE. ELECTRICAL WIRING COULD HAVE BEEN SEVERED OR CRUSHED). | LOSS OF POWER TO CIRCUITS FED BY TRANSFORMER. SHORT CIRCUITS, OPENS AND SHORTS TO GROUND ON WIRING IN AREA. | CREW COMPARTMENT EQUIPMENT BAY. |

TABLE 4.3-2        CRASH/FIRE DAMAGE ANALYSIS (SHEET 2 OF 2)

| CASE NO | OPERATIONAL MODE | ABNORMAL ENVIRONMENT | CAUSE | DAMAGE MECHANISM | ELECTRICAL CIRCUIT EFFECT(S) | ELECTRICAL FAULT(S) | PRIMARY LOCATION |
|---|---|---|---|---|---|---|---|
| 8. | FLIGHT-CRUISE | CRASH/FIRE | AIRCRAFT FAILED STRUCTURALLY IN TURBULENCE - EXCESSIVE BANK ANGLE | VIOLENT FORCES DUE TO INERTIA, GRAVITY & WIND FOLLOWED BY IMPACT & FIRE | WIRE BUNDLES SEVERED, PINCHED TOGETHER, GROUNDED & MELTED | ADJACENT WIRES SHORTED TOGETHER | OUTER WING AND AFT FUSELAGE. (NO WEAPON CIRCUITRY) |
| 9. | FLIGHT-REFUELING/LANDING | CRASH/FIRE | MID-AIR COLLISION WITH TANKER WING FAILURE AND FIRE AFTER LANDING | IMPACT FORCES ON RH INBOARD WING LEADING EDGE; TENSILE FORCES & GND FIRE | WIRES PINCHED TOGETHER; WIRE BUNDLES SEVERED & GROUNDED TO STRUCTURE; WIRE BUNDLES MELTED TOGETHER | ADJACENT WIRES SHORTED TOGETHER; ADJACENT WIRE BUNDLES SHORTED TO COMMON GROUND. ADJACENT WIRE BUNDLES SHORTED TOGETHER | INBOARD WING ROOT LEADING EDGE |
| 10. | GROUND-POST-LANDING TAXI | FIRE | PRESSURIZED HYDRAULIC FLUID LEAK ON BRAKE FRICTION SURFACE | HEAT & FLAMES FROM BURNING HYDRAULIC FLUID & TIRES | WIRE BUNDLES MELTED TOGETHER; ELECTRICAL COMPONENTS HEAT DAMAGED | ADJACENT WIRE BUNDLES SHORTED TOGETHER; ALL EQUIP FAULTED TO GND | MAIN GEAR WHEEL WELL |
| 11. | FLIGHT-TAKEOFF | FIRE | NO. 4 ENGINE STARTER TURBINE DISINTEGRATED | SHRAPNEL FROM TURBINE WHEEL FOLLOWED BY FIRE | WIRE BUNDLES SEVERED; WIRES PINCHED TOGETHER | ADJACENT WIRE BUNDLES OPEN; ADJACENT WIRES SHORTED TOGETHER | INBOARD WING LEADING EDGE |
| 12. | FLIGHT-TAKEOFF | FIRE | TIRE FAILURE SEVERED HYDRAULIC LINES AND ELECTRICAL WIRING | BLOWN TIRE SECTIONS STRUCK RELAYS AND WIRING | WIRING SEVERED & GROUNDED TO STRUCTURE; RELAYS CRUSHED | ADJACENT WIRE BUNDLES SHORTED TO COMMON GROUND. RELAYS FAULTED OPEN AND CLOSED | MAIN GEAR WHEEL WELL |
| 13. | GROUND-TAXI | CRASH | COLLISION WITH PARKED AIRCRAFT DUE TO FAILED BRAKES AND STEERING | METAL SHEARING & CRUSHING | WIRE BUNDLES SEVERED OPEN OR SHORTED TO COMMON GROUND; WIRES PINCHED TOGETHER | ADJACENT WIRE BUNDLES FAULTED OPEN; SHORTED TO COMMON GROUND; ADJACENT WIRES SHORTED TOGETHER | LOWER FORWARD CREW COMPARTMENT & LEADING EDGE OF EXTERNAL STORES MOUNTING STRUCTURE |

TABLE 4.3-3   CRASH/FIRE DAMAGE ANALYSIS FINDINGS

DAMAGE MODES

o WIRE BUNDLES SEVERED
o WIRING PINCHED TOGETHER
o WIRING SHORTED TO STRUCTURE
o WIRE BUNDLES MELTED TOGETHER
o ELECTRICAL COMPONENTS
  HEAT DAMAGED
o RELAYS CRUSHED
o COMPONENTS CRUSHED
o WIRE BUNDLE INSULATION CHARRED
o CRACKED INSULATORS
  BETWEEN PINS

FEASIBLE LOCATIONS

o INBOARD WING LEADING EDGE
o INBOARD WING ROOT
o EXTERNAL STORES STRUT
  LEADING EDGE
o MAIN LANDING GEAR
  WHEEL WELL
o LOWER FORWARD CREW
  COMPARTMENT
o CREW COMPARTMENT
  EQUIPMENT BAYS
o WEAPONS BAY IN FUSELAGE
o BODY PRODUCTION BREAK
  BULKHEAD FORWARD
  OF WING

ELECTRICAL FAULTS

o ADJACENT WIRES SHORTED
  TOGETHER.
o ADJACENT WIRE BUNDLES
  FAULTED OPEN, OR SHORTED
  TO COMMON GROUND.
o ALL EQUIPMENT IN AN
  ASSEMBLY SHORTED TO
  GROUND.
o SHORT CIRCUITS BETWEEN
  ADJACENT PINS.
o LOSS OF POWER FED BY
  FAULTED COMPONENT.

AD-A103 951    BOEING AEROSPACE CO  HOUSTON TX                    F/G 15/6
              ELECTRICAL ANALYSIS OF B-52/FB-111 AMAC AND RELEASE CIRCUITRY U--ETC(U)
              OCT 75                                            F29601-76-C-0017
UNCLASSIFIED   D2-118576-1                                       NL

END
DATE
FILMED
0-81
DTIC

## 4.3.5    Conclusions

As a result of the accident analysis, the abnormal environments were defined
in terms of generalized fault modes for use in the power and load analyses
of B-52 and FB-111 aircraft nuclear weapon circuitry. It was concluded that
under crash/fire conditions, wire-to-wire short circuits were confined to
common cables and connectors in all known cases. It was also concluded
that internal short circuits may result from any wire contacting any other
wire in the same component. The accident analysis confirmed that faults
postulated for the power and load analysis are feasible.

D2-118576 -1

APPENDIX A

B-52G/FB-111A

TECHNICAL DATA UTILIZED

FOR POWER AND LOAD ANALYSIS

## TABLE A1
## B-52G DOCUMENTATION

B-52G DOCUMENTS

| T.O. NUMBER | DATE | REV. | TITLE |
|---|---|---|---|
| 1B-52G-1 | 4/15/75 | Change 1 | B-52G Flight Manual |
| 1B-52G-2-12 | 12/20/74 | Change 55 | Electrical Systems and Data |
| 1B-52G-2-14 | 9/30/74 | Change 15 | Airplane Systems Wiring Diagrams and Data |
| 1B-52G-2-23 | 12/15/74 | Change 16 | Electronic Wiring Diagrams and Data |
| 1B-52G-2-26 | 5/30/75 | Change 8 | Bombing-Navigational System |
| 1B-52G-2-31 | 3/1/75 | Change 38 | Bomb Release System |
| 1B-52G-2-39GA-1 | 1/15/75 | | B-52/AGM-69A Weapon System |

# TABLE A1
## B-52G DOCUMENTATION (Continued)

**BOEING DRAWINGS**

| DRAWING NUMBER | REVISION | TITLE |
| --- | --- | --- |
| 21A13198 | D | Equipment Diagram Distribution Processor Group, Signal Data, B-52 |
| 25-2866 | B | Box Installation Right Hand Forward DC Power |
| 25-3541 | AA | Equipment Installation Electrical, Section 41 |
| 25-5049 | F | Power Box Assembly - DC Right Hand Forward (Item A216) |
| 25-5067 | D | Power Box Assembly - DC Left Hand Forward (A217) |
| 25-5231 | G | Panel Installation Circuit Breaker, RH Load Central (A113) |
| 25-5235 | K | Panel Installation Circuit Breaker, Aft BNS Overhead (A174) |
| 25-5557 | C | Shield Installation DC Power LH Forward |
| 25-7231 | E | Electrical Bundle - Bomb IND Panel, Assy |
| 25-7383 | E | Electrical Bundle - Inflight Control & Monitor Assembly |
| 25-7410 | G | Electrical Bundle - Control Flare Programming, Assy |
| 25-8054 | P | Equipment Installation LH Side Panel, BNS Operations' Station |
| 25-10091 | A | Equipment Installation - Panel Stowage, Special Weapons |
| 25-12066 | B | Fuse Installation - TR Unit No. LH DC Power Box, Kit |
| 25-12403 | L | Electrical Installation - Armament Provisions, Kit |
| 31-3516 | | Wire Harness |
| 31-3564 | | Wire Harness |
| 35-5417 | D | Electrical Bundle - Section 43, Assy of |

BOEING DRAWINGS

| Drawing Number | REVISION | TITLE |
| --- | --- | --- |
| 35-5419 | E | Electrical Bundle - Section 43 Assy of |
| 35-5427 | H | Electrical Bundle - Section 41, Assy of |
| 35-5497 | D | Electrical Bundle - Section 43, Assy of |
| 35-5531 | D | Electrical Bundle - Section 41, Assy of |
| 35-11014 | B | Shield Instl. DC Power, LH FWD (A217) |
| 35-11016 | L | Panel Instl. - Circuit Breaker, RH Load Central (A113) |
| 35-11301 | F | Power Shield Assy DC, LH Fwd (A217) |
| 35-11302 | F | Power Shield,Assy - DC RH Fwd |
| 35-11362 | A | Electrical Bundle - Simplified Weapon Provision - Kit, Assy of |
| 35-12642 | F | Panel Assy, Pilots Readiness SW |
| 35-12749 | C | Package Instl. - Radar Pressure, BNS |
| 35-12778 | E | Panel Installation - Pilots Readiness (D&W) Switch |
| 35-12938 | A | Electrical Bundle - Section 43, Assy of |
| 35-12939 | C | Electrical Bundle - Section 43, Assy of |
| 35-13009 | D | Electrical Bundle - Armament Prov's Wiring, Assy of |
| 35-13562 | C | Electrical Bundle - Control Flare Programming, Assy of |
| 35-13810 | A | Relay Installation - In-Flight Control, Fwd and Aft |
| 35-13841 | E | Kit Installation - Readiness P/W Switch For Nuclear Safety |
| 35-14355 | B | Electrical Bundle - Inflight Control and Monitor, Assy of |

BOEING DRAWINGS

| DRAWING NUMBER | REVISION | TITLE |
|---|---|---|
| 35-18096 | B | Kit Installation - Resistance Improv Monitor Control Circuits |
| 35-27389 | A | Circuit Breaker Instl. Kit - LH Fwd DC Power Box, AGM69A, (A217) |
| 35-28617 | C | Controller Instal. Kit - Coded Switch Set and P/L |
| 35-28618 | B | Relay Location Instl. Kit - In-Flight Control, Fwd & Aft and P/L |
| 35-28621 | A | Switch Installation Kit - Code Enabling and P/L |
| 35-29121 | D | Wiring Harness Instal. Kit - Coded Switch Set and P/L |
| 35-29257 | T | Wiring Harness Instl. Kit - AGM-69A Missile System Provisions |
| 35-58616 | A | Interconnection Box Instl. Kit - Coded Switch System |
| 39-24573 | Basic | Panel Assy Kit - IFC Power Select, Battery & Xmfr. Rect. |
| 39-24574 | Basic | Panel Instal. Kit - DCU - 9A Power, BNS Side Console |

AUTONETICS DRAWINGS

| Drawing Number | REVISION | TITLE |
| --- | --- | --- |
| WL30892-501 | A | Wire List - Network Interconnect Memory/ Logic |
| 30863-501 | C | Sch. Dia.-No. 1 Input Output Network |
| 30867-501 | B | Sch. Dia.-No. 2 Input Output Network |
| 30871-501 | A | Sch. Dia.-No. 1 Arithmetic Control Network |
| 30875-501 | B | Sch. Dia.-No. 2 Arithmetic Control Network |
| 30879-501 | A | Sch. Dia. - Power Control and Clock Network |
| 30883-501 | A | Sch. Dia. - Digit Network |
| 30887-501 | B | Sch. Dia. - Selection Network |
| 30891-501 | D | Sch. Dia. - Current Source and Timing Network |
| 31701-501 | B | Sch. Dia. - Voltage Regulator |
| 31707-501 | Basic | Sch. Dia. - Filtering Network |
| 31710-501 | Basic | Sch. Dia. - Timing Network |
| 31715-501 | Basic | Sch. Dia. - Regulator, Voltage-Series |
| 31721-501 | Basic | Sch. Dia. - Power Converter |

AUTONETICS

| DRAWING NUMBERS | REVISION | SHEETS | TITLE |
|---|---|---|---|
| WL30892-501-1 | A | 218 | Wire List - Network Interconnect Memory/Logic |
| 30863-501 | Basic | 1 | Schematic Diagram - No. 1 Input Output Network |
| | B | 2 | |
| | Basic | 3 | |
| | C | 4 | |
| | C | 5 | |
| | C | 6 | |
| | Basic | 7 | |
| | A | 8 | |
| | C | 9 | |
| | Basic | 10 | |
| | C | 11 | |
| 30867-501 | Basic | 1 | Schematic Diagram - No. 2 Input Output Network |
| | Basic | 2 | |
| | Basic | 3 | |
| | Basic | 4 | |
| | Basic | 5 | |
| | B | 6 | |
| | Basic | 7 | |
| | A | 8 | |
| | A | 9 | |
| | Basic | 10 | |
| | B | 11 | |
| 30871-501 | Basic | 1 | Schematic Diagram - No.1 Arithmetic Control Network |
| | A | 2 | |
| | A | 3 | |
| | Basic | 4 | |
| | A | 5 | |
| | A | 6 | |
| | A | 7 | |
| | A | 8 | |
| | A | 9 | |
| | A | 10 | |
| | A | 11 | |
| | A | 12 | |
| | A | 13 | |
| | A | 14 | |
| 30875-501 | Basic | 1 | Schematic Diagram - No. 2 Arithmetic Control Network |
| | Basic | 2 | |
| | Basic | 3 | |
| | Basic | 4 | |
| | Basic | 5 | |
| | Basic | 6 | |
| | Basic | 7 | |
| | Basic | 8 | |
| | Basic | 9 | |
| | Basic | 10 | |

AUTONETICS

| DRAWING NUMBERS | REVISION | SHEETS | TITLE |
|---|---|---|---|
| 30875-501 (Cont.) | Basic | 11 | Schematic Diagram - No. 2 Arithmetic |
| | Basic | 12 | Control Network |
| | A | 13 | |
| | Basic | 14 | |
| | Basic | 15 | |
| | B | 16 | |
| 30879-501 | Basic | 1 | Schematic Diagram - Power Control |
| | Basic | 2 | and Clock Network |
| | Basic | 3 | |
| | Basic | 4 | |
| | A | 5 | |
| 30883-501 | Basic | 1 | Schematic Diagram - Digit Network |
| | A | 2 | |
| | A | 3 | |
| | A | 4 | |
| | A | 5 | |
| 30887-501 | Basic | 1 | Schematic Diagram - Selection |
| | Basic | 2 | Network |
| | Basic | 3 | |
| | A | 4 | |
| | B | 5 | |
| | B | 6 | |
| 30891-501 | Basic | 1 | Schematic Diagram - Current Source |
| | C | 2 | And Timing Network |
| | D | 3 | |
| 31701-501 | Basic | 1 | Schematic Diagram - Voltage Regulator |
| | B | 2 | |
| 31707-501 | Basic | 1 | Schematic Diagram - Filtering Network |
| 31710-501 | Basic | 1 | Schematic Diagram - Timing Network |
| 31715-501 | Basic | 1 | Schematic Diagram - Regulator, Voltage Series |
| 31721-501 | Basic | 1 | Schematic Diagram - Power Converter |
| 21A11007 | Basic | 2001.001 | Power Regulator Unit |

# TABLE A2

## FB-111 DOCUMENTATION

| DOCUMENT NUMBER | TITLE |
|---|---|
| T.O. 1F-111(B)A-2-1 | General Aircraft Information |
| T.O. 1F-111(B)A-2-11-1 | Armament Systems |
| T.O. 1F-111(B)A-2-13-1 | Electrical Power & Lighting Systems |
| T.O. 1F-111(B)A-2-14 | Wiring Diagrams |
| T.O. 11B29-3-25-2 | Aircraft Bomb Ejector Rack Assy |
| T.O. 11B29-3-25-12 | Aircraft Bomb Ejector Rack Assy |
| T.O. 11F9-2-2, -3, -4 | Electronic Command Signals Programmer |
| T.O. 11F97-2-2, -3, -4 | Electronic Command Signals Programmer |
| T.O. 11G18-2-9-2, -4 | Stores Control Panel |
| T.O. 11N-T5036-2-3-4 | Station Program Units |
| T.O. 11N-T5037-2-3-4 | Control Monitor DCU-137A |
| T.O. 11N-T5054-2-3-4 | Station Program Units |
| T.O. 11N-T5055-2-3-4 | Station Program Units |
| T.O. 16W6-23-2 | Weapons System Pivot Pylon Assy |
| --- | Minutes of the Nuclear Weapons F-111 Model, Designation, and Series Project Officers Meeting (NW F-111 MDS POM 74-2) |
| Report - Leach Corp. to General Dynamics Corp. File No. 222-19-68 Dated March 26, 1968 | Subject: Monitor Relay (9324-8245) Technical Data |
| Memo Leach Corp. to General Dynamics Corp. (No Number) Dated September 26, 1968 | None - Referencing above report with corrections and additional data. |
| MIL-W-81044 | Military Specification for Standard Silver Coated Copper Wire |
| C2697 | General Dynamics Standard SCD for Circuit Breaker - Push-Pull, High Temperature, Trip Free |
| --- | Texas Instrument TC Series Circuit Breaker Data |